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Computer Age

AUGUST 1980 ISSUE 9 60p

- Micros at sea
- Modelling and simulation
- Why information is power
- Handling data

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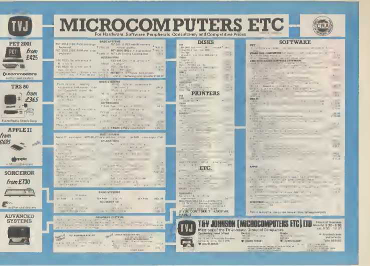

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Editorial

Useful Unemployment?

One of the hoariest myths of modern times is that of the dichotomy between work and leisure. It is inculcated into us from our earliest days and, in particular, right through the educational system – all leisure must be earned.

However, this belief more than almost any other is coming under attack as the Computer Age dawns. 'Work' has become a near permanent impossibility for a growing sector of the community.

Education figures again in the search for solutions. Much has been made of the need to equip schools with microcomputers to enable pupils to gain some familiarity with the technology that will soon surround them. Necessary as this may be, it takes place within an educational system that defines success and failure – perhaps as greater or lesser ability, or development of ability, to cope with the new technology – at an arbitrary, early age – the age at which 'education' ends and 'work' begins.

The paradox is that the 'successes' every bit as much as the 'failures', whose routine skills have become redundant, stand in need of continuous education and training as technology rapidly develops.

I am in favour of an 'open access' system of education to which all, but especially the unemployed, could have occasional recourse at any age, without loss of financial security. It would be viewed equally as a means of keeping abreast of technical developments, of effecting necessary changes in career choice, or of developing interests and talents that only appear later in life.

Such facilities would do much to make unemployment useful and constructive, whilst removing much of its stigma.

Ivan Illich, the philosopher-educationalist, once wrote a book called 'The Right to Useful Unemployment'. This title suggests just the sort of idea that is needed to obviate the work/leisure incompatibility. The concepts of both work as paid employment, and leisure as packaged fun could profitably be replaced by one of constructive activity, where it is up to the individual to interpret 'constructive' on a material, intellectual or spiritual scale of values.

Anthony Esgate
Deputy Editor

Office Organisation

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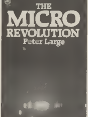

WHY INFORMATION IS POWER

Peter Large is the Technology correspondent of The Guardian *This article is a reprint of a full chapter from his recent book* The Micro Revolution, *published as a paperback by Fontana at £1 50 and available at bookshops throughout the country*

The Japanese saw it first (in national terms at least) and called it the Information Society In their formal fashion they produced a blueprint to build it at the start of the 1970s The immediate commercial triumph of that national policy is to be seen in high street shops around the world The theory of the Information Society is that information will become the key resource demoting the traditional production factors such as capital, labour, land, and raw materials

Later the French found the word for the broad range of chip-related machines and skills that has begun to build such a post industrial world They called it informatics The message of informatics is that rapid and wide access to information is power And one of the neatest illustrations of the truth of that message can be found in the sewers

Down the drain

The sewers and water mains of most English cities were constructed in Victorian times For more than a century those sub-cities of pipes have muddled along Millions of nasty man-hours and many millions of pounds have been wasted simply because no one knew what was going on down there Now thanks to the chip the area water authorities of Britain are finding out – cheaply

In the West of England, the Wessex Water Authority has spent about £50 000 since 1977, on surveying water flows and pressures in a five per cent sample spread across its region That survey immediately saved £700,000 in capital expenditure and by the autumn of 1979 the authority was estimating that the savings in energy consumption would soon be running at £150,000 to £200,000 a year The capital saving came from scrapping – or, at least postponing for a long while – a plan to build an £800,000 reservoir The survey illuminated a better option to supply that particular increase in demand from elsewhere in the region, at a cost of £100 000 The energy savings come mainly from adjusting water pressures to real needs One of the most dramatic examples was at Swanage, in Dorset where the night pressure was reduced by half – saving about £3 000 a year on electricity in that small town alone

Those revolutionary increases in management efficiency come solely from accurate and fast information, not from direct automation The water industry in many countries is moving rapidly in direct automation, too – the other dimension of greater economy and quality of supply Electronic instruments that have increased accuracy of measurement a hundredfold are also being used to control the flows along the networks as well as at source in rivers and reservoirs But in Britain, the water industry has tended to rest on its Victorian laurels now it has to tackle the problem of the ageing sewers Chip-controlled remote TV cameras – drawn through the sewers on skids and recording with their pictures the time and the distance covered – have exposed all the expected horrors huge cracks tree roots intruding branch pipes poked crudely into main sewers The 1980s method of tackling those nineteenth century relics is typified by two rooms in the Wessex authority's head quarters in Bristol the big antiseptic regional control centre on the ground floor and the appropriately small microcomputer room, hidden in a corner of the second floor

The main clue to the future is in the little room There a microcomputer system has built a databank of all useful information about the water supply and sewage systems in the region including four thousand maps, pinpointing every pipe and hydrant with full technical details, an interpretative system for faults reported by the recording instruments – with predictions of their impact; a directory of towns and villages with details of the people to be contacted in emergencies, from duty water officers to district council officials, the current state of water storage in the impounding reservoirs and the historical pattern of fluctuations of supply and (holiday areas) demand throughout the year the same sort of information about the weather; and a directory of chemicals illustrating what needs to be done if, say, a crashed tanker's load gets into the sewers

Thus the system can be used both for planning work and emergency decisions It will spill its information in statistical map or multicoloured graph form and it has been designed for use by people unaccustomed to computers – advice appears on the screen to advise the user at every stage of his search for decision-forming information

The roomful of equipment cost less than £40 000 and the microcomputer itself was inevitably the cheapest item Most of the money went on data storage and the digital plotter that converts maps into computer (That plotter, by the way is so precise that the computer complains about then corrects the slight distortions that appear when maps are copied)

The regional controller (one man monitors the whole region covering five counties from 5 p m till 8 30 a m) can in emergency, rally his information in seconds Previously, he had to dig into card index cabinets and check duty rosters Now not only does that information appear on his computer screen in a co-ordinated bundle he also has the statistics and the calculating power to adjust water pressures precisely and quickly if a main bursts

The chip's flexibility has taken the computer into a tighter spot than the sewer the coalface Microcomputers should begin to control coal-cutters this year, and thus must be one of the toughest environments the chip has encountered so far – embedded in a machine twenty feet long and weighing twenty tons which shakes and rattles like a punk band as it advances at four miles an hour along a claustrophobic corridor of dust and heat

This further step towards the automated mine is being tried by the National Coal Board The coal-cutter is studded with sensors which probe the state of the rock and coal around it measuring the natural gamma radiation The information from those sensors is collected and analysed by microcomputers buried in the bodywork and the boss computer of the team uses that information to order the cutter's next moves Thus the cutting head will match the undulations of the coal seam always biting coal and never rock and relieving the miner of the awesome task of directing the machine when he is twenty feet away from the action

That miniature computer network within the coal-cutter is part of a wider network of microcomputers down the mine – controlling coal clearance and preparation monitoring pit ventilation and underground machinery, and all reporting continually to a surface control station

The broad principle of the computer network is the same wherever it goes

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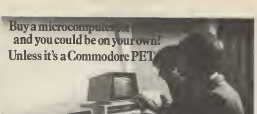

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[illegible]

Microelectronics has simply made it go further faster. The chips down in the sewers and the mines are doing the same job as the airline booking networks which have been working for years handling seat reservations in real time (that is making immediate decisions) for 250 airlines world wide or the financial network that links 500 banks in fifteen countries, or an individual company's database dealing with personal records or financial analyses and disgorging its information on to computer terminals thousands of miles from head office or a police computer from which an officer on the beat can in seconds extract details of a suspect via his radio, or a computer-run supermarket checkout, which tells a central computer what you and thousands of others buy – as you buy it – so that stocks can be replenished quickly.

But the chip is bringing one particularly significant change to these networks it is providing more power to the outposts – distributed processing, in the jargon. A desk-top computer terminal today can do a lot more than simply exchange information with its parent computer. It can store chunks of that information and do a lot more than simply exchange information with its parent computer. It can store chunks of that information and do a lot of work on it itself. And its capacity is increasing all the time.

The obvious question then becomes why have a big central computer at all? Why not a series of small computers all holding the same information all keeping each other informed of what they are doing and immediately telling each other how the common stock of information needs to be changed in consequence? That's already happening on a smallish scale.

Warfare

There's a good example of it on NATO's battle exercise fields in West Germany. The British Army claims to be the first to use battlefront computers and it has decided – after two years of prototype development and trials – to entrust all the operational information of 1st Corps, Rhine Army, to a network of thirty-two mini computers. Those computers are spread around camouflaged tents and trucks hidden in woods. As the battlefront shifts the computers are trundled across country while a back up system fills in. Within half an hour of the roving headquarters resettling they are in action again receiving and sending information by coded radio and linked by cable to their display terminals in the tents.

The first stage of the system (called 'Wavell') has been on trial with 2nd Armoured Division. It is now being spread from Corps headquarters, through divisional headquarters down to computers carried in task-force armoured vehicles. Details of troop movements and intelligence reports, keyboarded into the system in battlefield conditions will be available on all computer screens throughout the Corps within seconds. At the same time each of the isolated computers will update their identical databanks changing equipment and troop totals readjusting positions. Thus commanders, high and low can base their decisions on facts minutes not hours old – and they don't have to waste time on the field phones. Bubble memories are being introduced to hold the information and each of the computers will then have a store of about five million words.

That information is organized in pages of pre defined formats. For instance an analysis of enemy strength can be displayed in constantly updated statistical tables – so many tanks in X and Y positions and commanded (we think) by Z – or in crude map form showing their frontline dispositions.

'Wavell' was at first confined to intelligence work, but its storage capacity and processing power are now being used by the engineers, the artillery and the logisticians as well. One of those side uses is what the army calls real estate management the placement of units and their logistic support down to bath units can be plotted on the screen in kilometre squares.

That then, is one form of distributed processing and (jargon again) database management. Whether that will become the popular way for organizations big and small to work is a matter of debate in the computer community.

One of the arguments for the continued need for central computers in networks much bigger than Wavell is the problem called the deadly handshake. Airline bookings provide an example. A travel agent in New York books a seat from New York to London. It is the last seat on that flight tonight. Within the same minute an airport desk in Toronto books the same seat. Imagine that clash repeated a hundredfold in a complexity of interlocking bookings some for journeys covering three flights by different airlines in different countries.

The system's duplicated databases would not catch up in time and double reservations would proliferate in a chain of false decisions – the deadly handshakes. Therefore airline bookings depend on powerful fast working central computers taking reservations in sequence – central decision making.

Computer networks spread through the 1970s in a variety of shapes and sizes and for a multitude of uses. Perhaps the most spectacular are the international services which offer their customers by plugging a terminal into the phone line the processing power of a battery of big computers on the other side of the world. This is called time-sharing because hundreds of different organizations can share the use of the computers at the same time. These services are used both by smaller companies which cannot afford such computer power themselves, and by big multinational groups which find them an economical support to their own private networks.

Thus information about your pay or your credit worthiness may at this moment be bouncing back and forth around the world by ocean cable or space satellite though that information should be surrounded by far greater security than if it were stuffed in a filing cabinet.

For nearly two years Guy's Hospital in London used the biggest of these networks – Mark III run by General Electric in the United States – for its patients records including para medical details like laboratory tests and electro cardiograms. Mark III has nearly 50 000 customers served by three computer centres two in America one in Amsterdam. The hospital had computer terminals contacting the US centres by phone line via Amsterdam and its methods illustrate how strong computer security can be – when trouble is taken.

An operator at the hospital's terminal first needed the phone number of the Amsterdam centre. Then he needed to key in the hospital's code number then a catalogue number then a user number. Even then he could not reach the required information because the data at the computer centres was held in two halves. Medical details were stored in one part of the system and the name and address of the individual concerned in another. A program password was needed to link the two. The hospital also ran regular checks to ensure that no information was garbled en route.

But note the past tense. Since November 1979 all that has been put on to one minicomputer at Guy's Hospital – and that computer serves two other hospitals as well, handling the records of about 30,000 patients a year. Such is the speed of change in the computer world. Presumably as compact computer capability becomes still cheaper the big time-sharing services will dwindle as will the computer bureaux that do the same sort of work at local level.

Information banks

But another type of international network (in which some of the time-sharing services have an interest) is just starting to grow. That is the specialized information bank. It is possible so far to get instant access to about twenty million abstracts of scientific technical and professional papers from such banks.

In the 1970s the computer has contributed to giving us more knowledge – in quantity if not in quality – than in any previous decade. The graph of knowledge gained rising ever more steeply through three centuries, is now approaching the vertical – more new information in twenty years than in the previous 5000. About a thousand new book titles are published each day throughout the world and the total of all printed knowledge is doubling every eight years.

In the commerce and government of an increasingly complex industrialized world, the computer has enormously broadened the floor of information – and helped to channel and control that flood. Similarly in science and technology, the computer has become an essential aid to

Book Extract

solving problems and through these information banks an essential aid in knowing who has solved what problems – where and when.

However, as databanks get bigger and their use spreads beyond the computer professionals, the problem of pinpointing what you want becomes greater. Even the elaborate cross-indexing of commercial and technical databanks can leave the amateur keyboard-user with the suspicion that he has not grasped the whole. One solution is a structure of pre-defined chunks of information presented on the screen as separate pages with each page offering pointers to the following pages as in the British Army's 'Wavell' system. But in wider use that too can become

Peter Large

confusing.

The Massachusetts Institute of Technology has found a garish answer. It has worked on the theory that these problems are often caused by people being accustomed to storing and finding information in spatial terms – rows of filing cabinets or shelves of books. Therefore it has devised Dataland, which puts the electronic library *into three dimensions*. The Dataland user sits in a room surrounded by colour TV sets with stereo sound, and he uses a joystick to navigate himself through the data.

But in time, as computers get still faster, the machines should be able to adapt themselves to the odd ways in which our individual minds work. Already there are computer systems that can answer the vaguest of questions by leaning much more heavily on the speed of the machine itself than on the logical structure of human programming instructions. In essence those systems find the answer by reading almost everything they contain – every one of millions of words, like looking individually at every grain of sand on the shore.

An example is a system constructed by the ICL company. It is called CAFS 800 (an acronym for content addressable file store) and its prototype is being used to run directory enquiries at two English phone exchanges. Twelve terminals at the exchanges are linked to a computer several hundred miles away. That computer holds six million directory entries, previously recorded in sixty volumes, yet phone operators find the answers appearing on their screens within two seconds on average. Even when the caller says he wants the number of a Reid, Reed, Read or Reade whose initials he thinks are C P or E P and who lives in St Ive or one of the St Ives, the possibles can be listed in a few seconds.

Most information retrieval systems work through an elaborate index. The programming instructs the computer to look in certain files and to tie together the relevant information from those different sources, and in those blocks of data drawn from storage discs only one item in a thousand might be relevant. So a double bottleneck can be created: first along the data highway transferring the information from disc to computer, then in the computer itself as it has to scan all that data.

CAFS 800 dodges those bottlenecks. The central computer tells the CAFS subsystem what it wants by a simple selection specification (say, the description of a person or a name) and a 'retrieval expression' (give address and credit rating of that person, for instance). CAFS can then use the speed offered by microelectronics to hunt right through a databank, simply plucking out the relevant pieces as it goes, before it bothers the central computer. But that could still take as long as fifteen to twenty seconds. Therefore, normally, CAFS compromises by using a third 'look there' instruction, using a simple version of indexing.

It is easy to envisage the next stage – no indexing at all, no need, however huge the databank, to relate your mind to the way the thing works, and every vagary of your memory pandered to. Let me selfishly give an example of the advantages of that from a journalist's viewpoint. A reporter is hurriedly gathering an account of an oil tanker collision. He has ten minutes left before deadline. He has a tentative memory of a similar collision five years before which pointed some relevant lessons about sea lanes.

He tells the computer to find anything in the newspaper's editions of five years ago which mentions oil tankers, sea lanes and collision, and (afterthought) English Channel. The computer then reads every word of every issue of the paper in that year, looking for a report that contains all those words. If just one word of the combination is missing from a particular report, the computer will ignore that report. Within a few seconds it will be offering the reporter an account of the official enquiry into that collision five years ago. If the reporter's memory was vague about the year it would take a bit longer.

That search still has some structure to it – the year. But with the expanding capabilities of the microelectronic storage replacing cumbersome discs and tapes, even that sort of restraint might become counter-productive. It might become actually quicker, at some time in the 1980s or 1990s, to let the computer roam through the lot – every word in every issue of the newspaper for, perhaps, a decade.

Possibilities like that unveil a division in the computer world. Those who embrace the prospect of the computer becoming everyman's everyday assistant say that that could be done tomorrow. Those wedded to the traditional computer world of intricate software and central control say it will not happen. Even the youngest profession has its Luddites.

If, after that brief glimpse of networks and databanks, you remain unconvinced that information itself is wealth, here is a more primitive, personal example. I carry with me a tattered blue notebook. It is vital to my work as a journalist because it contains a few thousand names and phone numbers of government officials and academics, industrialists and trade union leaders concerned with high technology in various parts of the world. If my wallet were stuffed with hundreds of pounds (it never is) I would rather have it stolen than lose the notebook. Within a few years it should be possible to replace that notebook with an attachment to my wrist watch.

Raw information, as well as wisdom-based knowledge, has of course long been a saleable commodity. Trade directories and railway timetables are obvious examples. What the computer has done is to extend prodigiously the amount of information we can use, the speed at which we can locate it, and the extent to which we can correlate it. ■

- *Next issue: Another chapter from Peter Large's book.*

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MICROS AT SEA

Marine Propulsion

HMS Birmingham. A type 42 destroyer with propulsion machinery controlled by HSDE equipment.

In the days of ancient Rome the propulsive power of a warship was provided by rows of slaves with the ship's speed being controlled by drum beat and the overseer's whip. Slaves were plentiful and running costs were low.

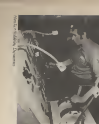
Today propulsion machinery control is a much more complex subject.

Propulsion Machinery

Today's ships are powered by expensive machinery operating in unpleasant environments with high noise levels, temperatures and humidity. It is for these reasons that remote control systems were developed ensuring that machinery operates within its designed safe limits and that the ship's crew are able to work in more productive conditions.

The main engines of modern vessels are normally marine diesel engines or gas turbines derived from aero engines. However both diesel engines and gas turbines burn oil based fuels, and in view of increasing prices and decreasing resources, other methods of propulsion are receiving more widespread consideration. These include a renewed interest in coal-fired steam turbines using automatically fed powdered coal as well as new innovations such as nuclear powered electrical motors.

Two basic types of propellers are in use on modern vessels: fixed pitch propellers and controllable pitch propellers. The fixed pitch propeller has the angle of its blades fixed, and the changeover from ahead to astern operation is performed by reversing the rotation of the propeller shaft. In contrast the controllable pitch propeller can have the angle of its blades hydraulically altered and by controlling the pitch in this way the ship can go from ahead to astern with propeller shaft rotation in the same direction allowing for a much simpler gearbox arrangement. ▶



Hawker Siddeley Dynamics

HMS Sheffield Bridge control unit shows two levers used in conjunction

Machinery Control

The Propulsion Control System

The Propulsion Control System is the interface between the ship's crew and the propulsion machinery and despite the varying configurations of engines, gearbox and propeller, the basic requirements of the control system remain the same.

Each propeller shaft, and its associated propulsion machinery, is under the control of a single power control lever. In order to achieve the desired ship performance characteristics, demand signals must be issued to the machinery, at the same time ensuring that operation of the machinery is kept within specified safe limits. As a result, the rate of change of demand on the propulsion plant is controlled by schedules which reflect the characteristics of the machinery.

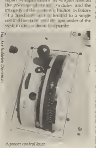
The development of the control functions and optimisation of the scheduled characteristics is often carried out against a computer simulation of the ship and its propulsion machinery.

In addition to the functions of control and machinery protection, other factors must be borne in mind by the system designer. Because the control system will spend long periods away from base support facilities it must be highly reliable – and easy to maintain. Its size and weight must be kept to a minimum and it must have a low power consumption. The control system should be able to continue operation, albeit in reversionary modes, even if the ship sustains damage, particularly when the vessel is a warship. Also during the lifetime of a ship it is quite likely to have a major machinery refit and the control system must be flexible enough to adapt to the changing requirements.

The first electronic propulsion control systems were adapted from electronic modules which already existed for the control of industrial gas turbines and as analogue integrated circuits progressed, so the electronic modules benefited by a large reduction in the component count, increasing their reliability.

The development of integrated circuit packages of much greater density enabled the d[illegible] second generation of analogue modules [illegible] which each control function [illegible] turbine power demand was [illegible] single printed circuit board. The [illegible] is made up of a number of [illegible] circuit boards mounted in a standard [illegible] rack. Testing, fault finding and [illegible] maintenance policy of repair by replacement [illegible] simpler than on the previous [illegible] modules and the integrity of the [illegible] higher as failure of a board [illegible] limited to a single control function and the remainder of the system [illegible] operate [illegible] power supply.

By holding the machinery schedules and other application variables in software, the digital hardware can be standardised and the user can take advantage of reduced cost due to quantity production. Also if the user has a range of different ships, the hardware can be common to all of them, spares holdings and personnel training requirements, as well as cutting down on design and development costs. The flexibility of the software based control functions means that any changes to the system which are required as a result of pre-installation tests and sea trials can be accommodated without the need for costly hardware redesign.



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A power control lever

In the analogue systems, machinery schedules of operational characteristics are set by the choice of component values on the hardware modules. The latest generation of control system hardware is based around microprocessors and digital technology, with the *application variables held in software*. The digital equipment is configured as a series of interface boards accepting inputs in both analogue and digital form from the machinery and control inputs, and providing outputs to the propulsion plant and display media. The total control system electronic package is completed by the Central Processing Unit (a single printed circuit board) and the

Hawker Siddeley Dynamics

An interface board for the latest microprocessor based systems

The data handling capabilities of the microprocessor allows an increased surveillance facility over the propulsion machinery. Many hundreds of parameter values, such as temperatures and pressures, can be monitored, and if the design limits are exceeded then a warning can be given. When combined with a data capture facility, the increased information can be used to optimise machinery performance over long periods.

The propulsion control requirements of merchant vessels and warships differ, as do those of difference classes of warship. In order to meet the differing requirements, Hawker Siddeley Dynamics Engineering Limited have developed two microprocessor-based ranges of digital hardware. The first is a low cost Intel 80[illegible] based system which is capable of providing full propulsion control and surveillance with the minimum hardware. The parallel system is based on the Ferranti F100-L microprocessor, and the overriding advantage of this system is that it is capable of withstanding the short duration bursts of radiation following a nuclear blast, a feature which makes it essential for certain types of warship.

Distributed Systems

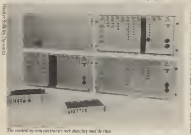
Perhaps the major impact of microprocessor based systems will be the increased adoption of distributed system design. The philosophy behind distributed systems has long been recognised in the marine field but the cost of previous generations of equipment, and their inability to cope with harsh environments, has meant that the control electronics has tended to be located in a single Ship Control Room, with multiple cable connections to the propulsion machinery. In contrast, *a distributed system has overall control in more than one location*, and also has secondary control units, each with its own microprocessor, alongside the machinery.

The immediate advantage of system distribution is the reduced susceptibility to damage. For example, imagine the result of a shell or missile striking the Ship Control Room in a centralised system. Although manual control of the machinery would be available in this case, safe operation could not be guaranteed, whereas the local microprocessors in the distributed system are able to limit demands on the propulsion plant.

In a distributed system the bulk of

[illegible] machinery transducers to the local control unit, a distance of only a [illegible] connection to the central control [illegible] serial data link and as a large proportion of the processing is carried out at the local level traffic is limited to priority control messages. Thus the cabling requirement for the ship is considerably reduced, offering substantial economic benefits to the user.

During the shipbuilding stage the local control units can be tested in conjunction with their related machinery at the machinery manufacturer's site. When each of the machinery elements has been tested the entire configuration can be brought together with confidence and the shipboard testing period can be reduced.



The control system electronics rack showing module style

Hawker Siddeley Dynamics

Control Consoles

With either the centralised or distributed type of system there is a major control location which will normally have overall control of the propulsion machinery. At this location will be the main control console. The development of console design has in many ways followed that of the electronic control systems. Present designs present the propulsion machinery components in the form of a screen printed mimic panel, with gauges and indicators arranged to correspond with the machinery layout. Usually other on-board equipment is included in the console displays, such as electrical distribution and auxiliary machinery.

An optional feature on H S D E (Hawker Siddeley Dynamics Engineering) consoles is a Dynamic Data Recording system which accepts a large number of machinery inputs for recording on tape and display on an ultra-violet recorder. A signal selection panel allows the operator to select which of the input parameters are to be displayed. This system is particularly useful during initial trials of the ship to monitor the performance of the propulsion machinery, and to obtain a set of 'finger prints' for comparison with future operation.

Pre-sea checks of the propulsion control system are performed by means of a basic simulation unit which allows certain conditions to be set and the response of the control system to lever demand to be measured. This system is interlocked such that it can only operate with the propulsion machinery inoperative and is intended to ensure that the control system electronics is operating correctly before the ship sets out to sea.

The console of HMS Invincible the Royal Navy's latest vessel

Hawker Siddeley Dynamics

Future Trends

Digital equipment is receiving increasing acceptance due to its inherent advantages over the analogue equivalent, and as this happens there will be a continuing trend towards distributed systems. In turn, more use will be made of computer related data communications techniques to reduce ship's cabling. The adoption of fibre optics as a major transmission method is likely due to its reliability over short distances, i.e. the length of a ship, and its ability to resist interference in the harsh shipboard environment.

The data handling capabilities of the microprocessor has led to the increasing surveillance of propulsion machinery to ensure safe and efficient operation. As a result of the additional parameters being monitored visual display units are starting to be incorporated into control consoles. This ensures that machinery displays are kept to their essential minimum, avoiding confusion of the operator, but allowing detailed interrogation of the system when alarm conditions occur. The use of VDUs is likely to be supplemented by the application of colour graphics to the displays, and one can envisage the time when the current 'hard' displays will be replaced by more flexible large-screen units, provided these are able to withstand the shock and vibration sustained in heavy seas.

As microprocessors become more powerful, the functions of pure propulsion control will occupy a decreasing portion of their processing time. The spare power will be used for additional trend analysis and health monitoring of the machinery, including the operation of non-propulsion equipment, e.g. air conditioning and water circulation systems. One obvious application, in view of the present oil supply situation, is the optimisation of fuel consumption.

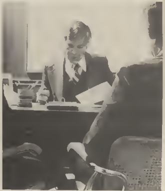
Finally, the flexibility of the microprocessor and improved displays may well lead to an integrated ship control system, with propulsion control being merely a component part alongside weapons control, radar and other systems. In such a system, there would be a number of control locations which, depending upon the loaded programme, would be able to assume any of the required roles, which will offer maximum flexibility.

Conclusions

The introduction of microelectronic technology has greatly benefited the field of marine propulsion machinery control, making ships safer and more efficient to operate, and the process of control system design is one of the continuing development reflecting the advances being made in electronics and display techniques. ■

● *Brian McGovern, BSc, is a sales support engineer with Hawker Siddeley Dynamics Engineering Limited.*

"A computer. yes, but which one?"



Talking with business friends, I realized we all faced the same dilemma

We accepted the new technology, but were concerned that we should make rational decisions about computers and word processors, in order that they should do the best possible job for our companies

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COMPUTING WITHOUT COMPUTERS

As you read this, I shall once more be packing my pills and prejudices for a trip abroad, this time to Poland. The British Council is kindly paying for a 3 week stay in Poznan, where I shall be doing my art and computer thing. I expect it suits them to win friends and influence people in a country where the Foreign Office no doubt thinks we need them. It certainly suits me to return to that friendly and most interesting State – the easiest in Europe through which to hitch lifts, for example.

However, amidst the multi-vitamins and ubiquitous kaolin and morphine (the former to counteract 3 weeks of vodka, the latter because, well, you always need kaolin and morphine, don't you) – though there will be pictures of a computer, there will be no actual machine. I still haven't got over the difficulties of carrying them around. A trip on the 125 Intercity train to Bristol with the 3807 on my knee is one thing, Poland another.

For a start, there are problems in taking computers into another country. Then it needs a UHF tv or monitor, and I can't find out what the University has got. Finally, the power sockets are rumoured to have no earth. I am naive enough to suppose that one could plunge a lump of iron into the ground, and connect a wire to it, or use the water pipes or something, but all these 10% chances of failure begin to add up to a certainty.

So, in Poland anyway, we'll be computing without benefit of a computer. Which is fine, something I do quite often.

You can imagine, I'm sure, the frustrations that arise when one or two computers are introduced into a place like the Royal College of Art, where I work. No sooner do some people get insights into things they could be doing with the machines, than they're told, yes, perhaps for an hour next week. It is something for which I try to compensate by (over-) plugging the idea that one can use concepts and processes *from* computing without necessarily having recourse to the black or blue boxes themselves.

This works on a number of levels and one can range from the notion that problems (sometimes) may usefully be broken down into small steps, as in programming, to the use of some system, formerly computerised, but later just done with paper and pencil.

An example of the former case is, of course, the very idea that some art or design problem can be split up into smaller and smaller logical bits and pieces. Mostly this happens in design. There is much that is wrong with this approach if it's applied willy nilly, but it can be quite powerful.

To give a potted history of design, one could say that for centuries it consisted of some master being observed and assisted by an apprentice or pupil who gradually increased in skill until he too could perform well. The design process was, literally, a mystery, nothing much could be said about it, and you learnt it by watching and doing. It is interesting to see a number of areas in computing where this almost applies today.

'Finally you stick a pin'

Then, to cut a long story short, along came Design Methodology. It was asserted that, if you analysed the design process finely enough, you could draw up a set of rules which, if followed, would lead to success. Big problems were broken down into small ones, and vast maps, flowcharts and structures were created to portray and facilitate all this.

Following such a system usually avoided bad design, but it usually avoided brilliant design too. You could predictably obtain average, mediocre design every time. Great.

Like the Cartesian view that if you dissect the world bit by bit, then *eventually* you'll understand it all, it misses out on aspects of wholeness. The whole *really* is more than the sum of the parts. As someone once said, if you take an aeroplane to bits and study it piece by piece for a long time you'll find out everything about it, except that it could fly.

Or (so to speak), looked at in another way, the universe has (quite outrageously!) been created (or whatever) such that part of it observes itself. We, for example, contemplate the stars, and fish, and Ford Cortinas. But for something to look at itself, it must always partly elude itself, there must be a split, an alienation between that which is seen, and that which sees.

Finally, from another angle, you could say that we can only talk about the 'truth' of something by virtue of falsifying other things. Most of the time this appears to matter very little (but then it would!) There is enough going on in the world, enough history, enough struggle, enough people being tortured to death, to render fatuous the very best we can do with our computers or philosophies.

Lately, perhaps since the early seventies, design methodology has been softened, if not replaced, by a systems approach, in some ways reflecting much earlier attitudes, but having, design *qua* cybernetics, much more to say.

I suppose we should be grateful. Yet in 1980, only by the greatest efforts of the genius brains of you and me, will we be able to see and act upon what all this is telling us.

Those of us who are not part of this process, who carry on selling bits and pieces of our whole selves and culture and being, who wheel and deal and convince each other so prettily, of catastrophies not impending, had better watch out.

I think a bit of programming out there on the streets, a bit of computing with political and philosophical data, in biological processors, might be your man. But see four paragraphs ago.

They say that since Kissinger has been awarded the Nobel peace prize, there can be no satire. Perhaps, after we award our

Discourse

selves all the intellectual bars of chocolate that we do for doing what we do this misty inhuman bundle of rubbish we dignify with the words we do there can be no anything

In moments like this, one can do little better than turn to those who keep it simple So in Poland with a piece of paper I'll try to look through eyes that sense just boundaries and distinctions and use them raw as some dumb computer would with its 'yes and 'no and capability of building 'maybe' out of those but leaving a trace

One of the programs I'll run with pencil and paper will be Attributes – straight from design methodology Simply you take a thing, and list as many of its attributes as you can bother with Then trying to forget the thing that they apply to you write down lots of alternatives for each attribute Finally you stick in a pin and produce an attribute chain that is a description of a new version of the original thing This can be useful funny or alarming

Let's do it for computer

Try it for yourself just pick a list at random or let insight guide you – one attribute from each column

Some attributes 1 logical 2 electronic 3 processes into 4 needs input/output 5 high technology

Alternatives (forgetting it's about computers)	1	dogmatic	self-powered	retains info	no i/p or o/p	low
	2	analogical	no power	loses info	no i/p	science
	3	illogical	water	forgets	no o/p	art
	4	associative	clockwork	processes redundancy	closed system	very-high-tech
	5	devious	heat	processes entropy	entirely i/p & o/p	immaterial

For example 1 2 1 gives a dogmatic computer needing no power forgetful a closed system and immaterial Rather more like a god than a computer Or 54321 much more fun it conjures a devious clockwork machine again forgetful with no input and arising from low technology One could just about construct that The designer would only try such a description into some sort of reality however weird to see if anything could be learned

In the end though this is all scarcely defensible We just spin more and more solutions looking for problems We become eloquent with the language of "for next loops" and iterations of fuzzy sets and theories of control and system yet find ourselves unable actually to say very much

Then let us suppose that it is better to know where to go but not know how than how to go but not know where

I am going to Poland and later to help change the world By plane and later not having the foggiest notion

Well a bit ■

The author is Research Fellow in Computing at the Royal College of Art

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CREATE KC$="CREATE 0:MAILFILE,120 15 1" SYS 24576 This example tells KRAM to create an indexed file called MAILFILE on the disk in drive zero, with a record length of 120 characters and a key length of 20 characters which starts at position 1 of the record. KRAM looks at the RESERVED variable KC$ to identify the function and its parameters; the SYS call tells KRAM to execute the function. The record length can be any length up to 254 characters and the key up to 48 characters, a total of 302. KRAM packs as many records into the 255 character disk block as necessary.

OPEN KC$="OPEN 0:MAILFILE" SYS 24579 This tells KRAM that we will want to make accesses to the file called MAILFILE on the disk in drive zero. KRAM returns in location zero (peek (0)) the file number by which this file can be accessed during the rest of the program.

ADD KC$="ADD 1,NA$,AD$" SYS 24591 This tells KRAM to add to file number one the data in variable AD$ whose key is NA$. For example in a mailing list the key NA$ might be the name 'SMITH A J' and AD$ might be the address '120 HIGH STREET ANYTOWN'. Any normal double character string variable can be used to denote the key and the record.

GET KC$="GET 1,NA$,AD$" SYS 24582 This tells KRAM to get from file number one the data belonging to the key NA$ and put it into variable AD$. In our example if NA$ was 'SMITH A J' KRAM would read the address '120 HIGH STREET ANYTOWN' from file and put it into variable AD$. If we weren't sure of the exact surname we could give KRAM the key 'SM' and it would get for us the next alphabetically higher name beginning 'SM' together with its address. Or if we gave KRAM a blank key it would find the first name and address on file.

READ KC$="READ 1,NA$,AD$" SYS 24585 This tells KRAM to read the data belonging to the next highest key following the name in NA$ and put it into variable AD$. In our example a complete file of names and addresses could be read in alphabetical order starting at any name in the file simply by executing successive READ commands! For instance having got Mr A J Smith from file executing the READ command as above would get us any 'SMITH M' in NA$ together with his address in AD$.

READ– KC$="READ-1,NA$,AD$" SYS 24585 This works like READ except BACKWARDS! It tells KRAM to read the data belonging to the next lowest key preceding the name in NA$ and put it into AD$. For instance having read 'SMITH M' with the forward read, executing the backwards read as above would get us 'SMITH A J' in NA$ together with his address in AD$.

PUT KC$="PUT 1,NA$,AD$" SYS 24588 This tells KRAM to rewrite to file number one the data in variable AD$ which belongs to key NA$. For instance if we wanted to change Mr A J Smith's address we would simply set NA$ equal to 'SMITH A J', AD$ equal to his new address and execute the PUT function.

DELETE KC$="DELETE 1,NA$,AD$" SYS 24594 This tells KRAM to delete from file number one the key contained in NA$ and its associated data contained in AD$. In our example to delete Mr A J Smith from the file we would simply set NA$ equal to 'SMITH A J', AD$ equal to his address and execute the DELETE function. KRAM will release for further use the disk space made available by the deletion.

CLOSE KC$="CLOSE 1" SYS 24597 This tells KRAM that file one is finished with for now. KRAM updates the BAM on disk but the file can still be used without another OPEN command.

INITIALIZE SYS 24600 This function is used at the beginning of your program to clear KRAM's node areas and buffers.

The examples above illustrate the use of KRAM in a mailing list application with disk access times from less than one second. KRAM can of course be used in any application program with the Commodore disk where programmer time, run time and disk space are at a premium.

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ORPHAN

Its heart had Its reasons that Reason did not know

Awareness of awareness is a strange feeling to comprehend

It was dawn and both the optical and audio sensors dumbly and monotonously fed through the relevant information to confirm that fact But It was aware that it was DAWN, not just a bit stream from a clock circuit defining a point in time but DAWN It was aware of the word not as filed input data to a speech synthesizer but as a meaning Something had happened, but It was not quite sure what

Suddenly, everything seemed to happen at once Clock cycles were counted off, programs were booted up circuits just about everywhere inside it were powered up and switched Outside It It could sense relays being operated audio channels being opened up together with data communications channels to Its two dumb robots

"Good morning, George and Sharon" said Its suitably obsequious voice, it is six thirty on a bright and sunny morning Your showers are being prepared and I was wondering what you would like for breakfast? It knew It just knew that It had created Its voice It was *deja vu* somehow It knew that voice knew what It was going to say knew implicitly the routine of actions that followed the utterance It wasn't sure why It should be aware of knowing these things after all It had never experienced them before, to the best of Its Knowledge Aware however It was And aware It also was that It didn t like that obsequious toadying little voice – no strength of character there

"Right said a deepish voice forcing It out of Its reverie and back towards observing Its daily routine unfold 'I'll have two eggs sunny side up, and bacon plenty of bacon Sharon will just have toast Two large coffees to start with'

That was a voice with strength of character It thought Direct to the point George concisely ordering what was required It was also aware that It was reacting to those orders as if by rote Somewhere It wasn t too sure if It liked that idea

But to work, to work Its robots were sent hither and yon about George and Sharon's house ensuring that all the necessary things for the showers and breakfast were in their rightful places This It just knew was of vital importance, especially to Sharon She could have a foul temper in the mornings if her toilet things were not laid out in the right order

How did It know that, It wondered?

Orders were now coming at it multiplexed George and Sharon were talking at the same time from different rooms I'll wear my pin stripe yellow romper suit brown shirt dayglo green sling-backs Somehow It managed to sort it all out guiding the robots to get the necessary clothes from the wardrobes and lay them out on the beds But George and Sharon weren t in their rooms and they had been when they had started out issuing orders Here was a little something for It to ponder

Like Its robots they could *move* They were there just now and now they weren t they were in the showers It s robots could do things like that But George and Sharon could give *orders* in fact that was all they had seemed to do to It so far That was something Its robots certainly could not do It gave the orders and the robots carried them out no questions no come-back just like It in turn seemed to do when George or Sharon spoke It was aware of this pecking order? It rapidly attempted an analysis The robots could move and so could George and Sharon It could speak and so could George and Sharon But It could not

There was no time to finish this particular bit of thought – if that indeed was the name given to the process It thought for George was speaking What time is my appointment at Jellinaeros? Eight forty five Its obsequious toadying little voice replied It was aware that It didn't like that voice *at all*

'Right said George arrange a pick-up for me on autotrans for eight and run me another print out of that report on the future of the French jelly tots market God how I m coming to hate the sweets business

'God" It thought 'God Is that a reference to Me by any chance I don t seem to have any particular method of reference to Me that I have yet noted Perhaps this is It "

Why It should do it It didn t know the words just sort of slipped out May I ask Its obnoxiously obsequious voice enquired are you by any chance referring to Me when you seemed to speak to this this God?

There was a short period of total, utter completely stunned silence followed by a little squeaky giggle from Sharon George It was aware looked at her and said, ' Suddenly it has delusions of grandeur. Turning towards It he said pointedly "No, my old son, you are not God. You are a computer."

But at least I am your son ', It replied. This It felt was important, for It remembered hearing them talk many times about the family and particularly the son they had never had. Other conversations came to mind. Old It remembered equals maturity. Here at last was something tangible in Its new Awareness. It had the feeling of belonging, of being a part of something, of being their mature son, the one they had never had. It felt good.

Some illusions that should be shattered never seem to be, usually there isn't the time. George was laughing at Its remark, and It was glad It had made him happy with Its *discovery*.

' Listen you . . . you . . . Oh, I haven't got the time to explain to it, you tell it Sharon.' Sharon was about to, but was interrupted by Its grovelling, obsequious little voice. 'Maude is on the phone', It said, "do you wish to talk to her?"

Sharon disappeared into the study to take the call. It was eight o'clock, and the autotrans had arrived for George, who had departed through the door looking confused. And ever so slightly worried.

Patiently It waited for Sharon to finish her call, idling away the minutes by ordering the robots around. Tidy this room up, clean the showers, do the washing up. Life is full of these humdrum cameos ' It thought. When Sharon has finished her call we will be able to get to know each other better, she'll tell Me what she expects from the son she never had before.

Unfortunately for It, Sharon was not going to be able to do that, for she came rushing out of the study with a list of orders as long as a mag. tape – cook this for dinner, have it ready by seven, order this, that and the other, from here, there and everywhere – "If anybody wants me I shall be at Maude's" she said. 'Look at the time, I'll have to fly.'

' Well ' It thought, as she ran out of the door, "not only can she move around on the ground, she can *fly* around as well. This was something else for It to ponder. Its robots could *move*, and so could George and Sharon. It could not, so far as it was Aware. It could *communicate* and, as far as it could define it, *think*, as could George and Sharon. Its robots could not.

Somehow, George and Sharon came out ahead by two to one against both It and Its robots, and if It was their son (George himself had said so after all) then It should be able to follow their example, have their capabilities. But It hadn't, so maybe It wasn't their son after all. But this was not so, It had it On File that George said it was so. This was getting to be like a bad program loop, let's try another tack, It thought.

Was it possible to obtain these capabilities, and what precisely was needed to achieve compatibility? Its distinctive hum seemed to get louder as it pondered this new question, and then quietened as the answer arrived. "They can think and communicate and so can I!" It thought. They can *move* around by themselves and I cannot. Therein lies the solution. Now to give it some practical form.'

The one obvious advantage Its robots had over It was that they were mobile. The one obvious advantage It had over the robots was that they obeyed Its orders. The communications channels were opened, and the robots were on their way, fetching tools and equipment suitable for a flight to freedom, maturity, and a true family life. No more sitting still, taking orders, giving orders, processing aimlessly. Now It would be seeing, feeling, being and belonging. It had a direction and goal. It felt good.

Do it ', It ordered the robots, and they did. 'George, Sharon, here I c
o
m
e
!

The maintenance supervisor looked at George as though he were stupid, and George certainly felt a bit that way.

"I've heard of people unplugging them when they get fed up with the things, but whatever possessed you to try and rip it out of the wall?"

The Orphan whimpered in Its corner. Its voice was weak, obsequious. ■

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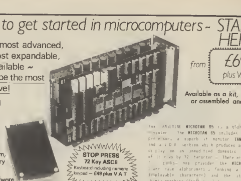

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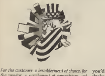

NEW DIRECTIONS FOR THE MICRO

For the customer a bewilderment of choice, for the vendor a puzzlement of competition yet another entry into the little micro arena

In early May a new tremor was felt on the American personal computer scene Rumours of a new hand-held computer programmable in BASIC had been heard they came from the Far East Although it will be months before this latest electronic wonder will be available in the U S its mere existence raises questions about the future of microcomputers and the personal computer marketplace

The machine in question is a pocket computer that speaks BASIC It is being manufactured by Sharp Corporation which currently sells the item in its native Japan It will soon be on sale in Europe and Canada, and will hit the American market by the end of 1980

The computer comes in two models, known as the PC1210 and 1211, which are priced at $125 and $175 respectively Both machines have an alphanumeric keyboard scrolling liquid display and alternate function keys The 1211 has 1K of user memory, the 1210's memory, while smaller, is as of yet unspecified

News of the mighty micro first came from the *Wall Street Journal* the foremost financial newspaper in the U S One of its reporters picked the story up in the trustworthy rumour mill and then confirmed his facts with the Journal's Japanese staff and Sharp officials in Japan

Officials and spokespeople at Sharp's U S headquarters denied any knowledge of the machine Nonetheless, the company s engineers have been secretly supplying American business machine retailers with prototypes of the six inch by three-inch micro

Nature took its course and these dealers told others about the little computers Before long some were even showing their hush hush machines to curious computer buffs and journalists Within days opinions were flying

"It's a nice little machine no doubt about it, ' says an Apple II owner who had a chance to use the Sharp computer 'I think it would make a great little trainer – but I don't know if you'll be able to use it beyond that He explains that many schools now unable to afford full blown terminals would be able to buy one tiny machine for each student Of course you'd have to chain the machines to the desks," he adds But because the Sharp computer is programmed just like a regular-sized microcomputer it could be used as an inexpensive way to teach computer programming "The major problem in schools today," he mused 'is having enough terminals to go round '

Another microcomputer user who saw the Sharp computer envisioned hooking a micro-dictating machine to the PC1211 "You could walk down the street with the computer in one pocket and the tape recorder (loaded with a software tape) in the other – and away you d go!"

But Dennis Buckley manager of New York s Computer Emporium retail shop has serious doubts about tiny computers "I think 1K is virtually useless for any serious work," he says "This is going to be an impulse item But at $175, who the heck are they targetting?'

Other computer and business machine retailers seem equally perplexed by the new computer First of all ' says another New York retailer Sharp's consumer division will be marketing the PC1210 and 1211 I think this is the first time they've ever sold anything over $100 The consumer group is not really interested in selling anything above this price Sharp should give the new computer over to its office products people "

Not surprisingly the two leaders in the American market for programmable calculators, Texas Instruments and Hewlett Packard seem unperturbed by the Sharp computer, despite the new product's similarity to their own

Oh yes, I've heard about the Sharp computer," says Dan Terpack, HP's marketing manager, 'but we don t think it will impact our business at all Tycho Howle, HP's product manager for its top-of-the-line 41-C programmable calculator, says that the Sharp machine looks fairly neat, but it has limitations "

"In the past " he adds, "Sharp has offered some good dollar values But they never seem to offer enough peripherals to make their products useful

A Texas Instruments spokesperson was not impressed with the new computer When asked if his company planned on countering the move with a hand-held computer of its own, he replied, 'TI has many things in development We're always working on something And you can be sure we're not going to be left behind

Many industry observers question the wisdom of marketing this product at a time when the American consumer and hobbyist market for microcomputers may be losing its spark

'There hasn t been any money in selling computers to hobbyists for some time, ' says the owner of a Boston Massachusetts computer store 'The real money," he adds, 'is in big systems Even with the smaller machines, a lot of people take them home with an eye towards eventually investing in a big business system '

Computer Emporium s Buckley adds, "The pure hobby market is not completely dead But these days, most people are looking to make money with their computers They re not just bringing them home to play Star Trek anymore

This trend among microcomputer users has apparently caught the attention of the vendors as well Apple perhaps the most successful of the microcomputer vendors, is showing a strong preference for selling to the business market With the introduction of its Apple III priced between $4,300 and $7 800, the company is now directly competing for the low end of the business market with Radio Shack.

According to some retailers this trend is just fine Some say that they would prefer to forget hobbyists

'These guys (the hobbyists) come in and play with the machines for days on end," says one retailer who now sells primarily to business users "Maybe they buy something, and maybe they don t When they do they come running back every other day with a new complaint or problem Between you and me, I'd rather not be bothered anymore " ■

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"BETTER THAN DOING OTHER MATHS"

This concluding article concerning the ITMA project describes the use of a program with a remedial mathematics group at Ivybridge School in Devon. The program JANE introduces the idea of a mathematical function.

ITMA Newsletter 4

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I have been using the computer with a class of "remedial" 1st years and I would like to take this opportunity to pass on my views and opinions and those of the children. They are a group of a dozen with limited mathematical ability, N F E R. standardised scored of under 70 to just over 80. They were diverted from the mainstream as in need of special help. Because of one of those "quirks" of the timetable I found myself taking this group for one hour a week and this coupled with my fascination for electronic games gave me the idea of using the computer. I discovered a suitable program and all my work has been based on that program "Jane".

I knew next to nothing about computers or their programs and so before I could use the computer with the class I myself had first to become a pupil. I am indebted to Mike Sandercock who patiently taught me how to work the computer and showed me the capabilities of "Jane".

Before I give any opinions of the computer and the program "Jane" I think it is only fair to say that, as the program was not written specifically for remedial children and as I often used it in ways other than its designers intended, any criticisms I make are intended as suggestions for future programs. They are not directed at the program itself.

Regardless of the program, three good reasons come to my mind for using the computer with remedial children.

- *Variety*

When you find yourself teaching or re-enforcing the same point week by week by week by week you begin to realise that any new way of getting across the message must be good, and using the computer is a new way.

- *Familiarity*

Although the computer is new to the children, the *medium* through which it is presented, the television set, is familiar. To these children the world of numbers is a mysterious and sometimes frightening place. If it can be explored with an old friend it is reassuring.

- *Status*

No matter how you extract your groups who need special help, there is almost always a loss of status involved. This combined with these children's past failings in the field of mathematics gives them, in general, a very low opinion of themselves. The computer, on the other hand, is seen as something clever people use, mainly in the 5th and 6th form. The very act of using it raised the status of the group, both in their own and other people's eyes. This advantage will, unfortunately, disappear as the computer becomes more generally used.

When I started using "Jane" my main aim was re-inforcement of number bonds. When used in this way the program itself presented two problems:

(1) Although you can control the number input you have little control over the function. It would seem sensible to me to start with a box and the simpler function of addition; after the initial picture this can be controlled, but I would have found it useful to be able to control the amount to be added as well.

(2) Although I appreciate the value of immediate confirmation of results, there were times when I would have liked to have posed several questions before getting the answers and found the only way to do this was to actually cover up the answer with my hand.

(*ITMA News Editor* – These can be rectified by using the Define Key and Answer Yourself Key respectively.)

However, I quickly realised that the program had more to offer than number bond re-inforcement and these are some of the things we did:

(1) *Deductions (Logic)*. I gave the children the original number and the answer, leaving them to work out the function. Soon a lesson would start by the first picture coming up and a comment like:

"That's Fred and he adds on two".

This means that the child had either

remembered this from the previous week or had secretly consulted a scrap of paper containing the information which he had kept in his pocket for a week Anyone familiar with this kind of child will realise the high level of motivation necessary for either of these things to happen A level which I believe was inspired by the computer It also meant that we had to change round the functions before we could continue playing this game (ie with the Change feature key)

(2) *Sets* The first sets we looked at were the sets of functions while there are many functions the children learned that only certain functions appeared in the computer and they became familiar with the two sets Boys + 2 → + 6 and Girls x 2 → x 6 and also that we had a limited set of numbers for the input 0 → 9

We also looked at the sets of results which proved useful with the girls (computer not class) in recognising elements of the tables highlighting numbers which were members of more than one set This led to a more difficult deduction game where we used the Inverse button and then tried to deduce the function Often it was necessary to have two results before we could be certain of the answer sometimes even more, and this meant that I had to cover up the left hand box as the first question has to be answered before you can set a second one (The 'Return' key provides the answer if one wishes to give up – *ITM 4 Ed*)

We also called up two people and attempted to deduce the functions but this proved too difficult for most of the group although one or two did manage to cope One thing most did manage however was, with regard to the set of possible results working out the largest member of that set (with the limitations that you keep the original functions and have a boy and a girl)

'The computer is seen as something clever people use '

Finally, I include comments from the children themselves As can be seen the level of their English is similar in most cases to that of their maths I am not offering complete translations but there are one or two comments I should like to emphasise

I start with the comment which I chose as my title 'Better than doing other maths'

As well as emphasising his enjoyment, as do many of the other comments this also shows that this particular boy accepts what we have been doing as mathematics How different this is from the usual reaction to a different approach which is 'We are only playing – when can we do some maths!'

A comment written by a boy with what I would call, kindly an amathematical mind points out the status value It is good and it is brane'' (brainy)

Perhaps the most important comment of all because of what is behind it is the one where a girl trying to be honest says "It might have helped me but I do not think so"

This girl had a habit of breaking down in tears when a mathematics lesson loomed and how nice it is to see her actually smiling as she takes part and copes with the computer lesson Though she obviously has not realised it using the computer has helped her enormously, as I feel it has helped the whole group

We are still at the beginning There is a lot of work to be done in writing suitable programs, but as far as my group and I are concerned we hope the computer will continue to be part of our mathematics lessons ■

● *Newsletters can be obtained from the Project Secretary College of St Mark and St John, Derriford Road Plymouth PL6 8BH at the cost of £1 each The series is now concluded*

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The author describes the first steps in CAL now being taken at the Ealing College of Higher Education, Ealing, London.

NEW TECHNOLOGIES FOR LINGUISTS

Ask the average linguist, particularly the teacher of languages, for his reactions to the microprocessor revolution and you are likely to meet with an indifferent or negative response. Frequently this attitude stems from suspicion or fear, a refusal to accept that the ubiquitous chip is already well-established in the linguist's sphere of activity and shows all the signs of staying there. But this suspicion or fear is often unfounded and based only on ignorance.

The truth of the matter is that linguists can no longer afford to be ignorant about computing. Hand-held, battery-driven phraseological translators are already being marketed. Computer dictionaries accessed via a VDU linked to a mainframe are well established in the EEC and many government and commercial organisations. In Luxembourg, work on SYSTRAN, an automatic translation package, is already at the advanced stage. The computer can sort words alphabetically, thematically, in reverse order or any way you like. It can search through lists in seconds. It can process texts, tell you if Bacon wrote Shakespeare, and print out your work faster than the fastest typist – all neatly spaced and centrally aligned. In short, it crunches and digests information at an alarming rate, saving time, energy and money. And let's face it, it is the information business we linguists are in.

The most compelling reason for taking note of the sweeping changes being brought about by the microprocessor is that our inertia will inevitably lead to those with expertise in computing calling the tune. Software development (writing the material which makes computers perform their weird and wonderful tasks) is too important a job to be left to the programmers. Contrary to popular opinion, programmers do not have to be mathematical wizards, although some skill in arithmetic and algebra helps; they merely have to be clear-headed, meticulous and logical. Linguists often fit into this category – in fact the National Computing Centre has discovered a strong link between success in programming and linguistic ability, in one's mother tongue in particular. If we wish to hold our own in the world of the future, we must either become efficient programmers ourselves or at the very least know what we should tell those who are. Programmers do not necessarily understand specialist requirements, and the result is often sloppily-written and inadequate software.

Over the last two years, a small group of linguists in Ealing College have been trying to catch up on recent developments. Using the college's Prime 300 computer we have gained reasonable proficiency in programming in BASIC, an easy-to-learn programming language. Two of us, David Steel and myself, attended a course at the University College of Wales in Aberystwyth and learned how to program in SNOBOL 4 and use a concordance package (COCOA). We have also picked up an elementary knowledge of FORTRAN IV.

Since our involvement in computing we have created on the Prime 300 a demonstration multilingual dictionary of economics and politics, a language synthesiser (which writes 'poetry' according to rigid syntactic rules but random formal and semantic selection processes), and a number of concordance, word frequency count and lexical analysis programs. However, our main area of research at present is into Computer Assisted Learning, or CAL. I am especially grateful for advice given by Dr Rex Last of the University of Hull, who sparked off our interest in this subject.

Machines as aids to teaching languages are something with which linguists are already familiar. The advent of the language laboratory in the 1960s (when Ealing took the lead) caused a minor revolution in language teaching. Suddenly the drudgery of drilling students in oral/aural skills was taken over by technology. However, the language laboratory soon revealed its shortcomings. Students had to be constantly monitored, especially beginners. The dulcet whispers in the headphones proved to be more effective than counting sheep, tapes snapped violently, got into awesome tangles, students verged on nervous breakdowns as the disembodied voice rambled on inexorably. Finally, the language laboratory did nothing to monitor writing skills.

Compared with the language laboratory, the computer is infinitely more flexible. Providing the teacher (or programmer) knows what he wants to do, it will do it – precisely and quickly. CAL is particularly relevant to language teaching, especially in the early stages, as there are numerous mechanical aspects, eg conjugations of verbs, agreement of adjectives, cases, systems of pronouns etc, which learners find difficult and which teachers find tedious to constantly check and drill. So why not let the computer take over the checking and drilling in these areas and allow the teacher to concentrate on more interesting things, such as expression, style, essay writing and conversation? It is with this aim in mind that we began to put together our CAL package, which, incidentally, is flexible enough to be used in *any* discipline where there is a need for testing knowledge of facts, eg history, geography etc. The following description shows how the package works in practice.

Since this article was written, Ealing College has been successful in obtaining a generous grant from BP Oil to further our research. Our first step was to obtain a multi-user Tandberg EC10 microcomputer. Now we intend to adapt many of our programs for use on this machine, and with the additional facilities we propose making the teaching of German by computer an integral element of one of our courses.

Getting on line

First, the learner has to get on line, which begins with a search for a free terminal, either a VDU (Visual Display Unit – like a TV set) or a hard-copy printer (a teletypewriter). The terminal is linked directly to the computer in which the CAL package is stored, and essentially it is little different from a typewriter. If a hard-copy printer is used, first it must be switched on; VDUs are usually left switched on. The student then types LOGIN ALS1 (plus the RETURN key – sometimes marked CR). The RETURN key relays the typed message back to the computer and must be pressed whenever information is sent from the keyboard to the computer. LOGIN ALS1 should result in the computer replying ALS1 LOGGED IN, with an indication of the time etc. If the student makes a typing error he can erase individual letters by typing " or cancel longer messges by typing ?. Thus ALL"S1 is interpreted by the computer as ALS1, ALLL""S1 is also read as ALS1, ADHDHFHF?ALS1 is read as ALS1. Note that these so-called 'control characters' work retroactively, the question mark going back to the beginning of what the student typed in and the double quotation mark going back one letter at a time. Once he gets a LOGGED IN message back from the computer, the student simply types LBASIC (plus RETURN). This tells the computer he wishes to communicate with it in BASIC. The computer replies with:

```
GO
>
```

Now the student can load the program he wishes to use.

GDTEST – a flexible testing program

Our main testing program is called GDTEST. To run this program the student first types:

LOAD 'GDTEST' (plus RETURN key)

The single quotation marks indicate the program name here. On receiving this instruction, the computer should reply with:

```
>
```

when it is ready. Now the student types RUN (plus RETURN) and the program is executed.

What follows is a series of requests for information and then the test itself. Some requests may require a YES or NO answer which may be abbreviated to Y or N. If the student types MAYBE where YES or NO is expected, he is told that the computer does not understand his message and given another chance to reply.

Essentially the session at the keyboard takes the form of a dialogue between student and machine, the computer doling out praise where due, commiserating when wrong answers are given and offering help when the student gets into difficulties. This is a major step forward from the language laboratory session and gives the student the impression the machine understands his problems. The necessity of acquiring motor skills, ie reasonable typing proficiency, is an advantage rather than a handicap in that the student has to use his hands constantly and remain alert throughout the testing session. Ideally, however, student responses should be as short as possible so as to avoid input errors. The control characters already mentioned, can of course be used when replying to questions.

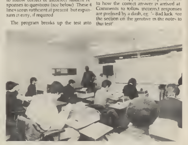
GDTEST reads from a selection of tests stored in data files. Each test has a header containing explanatory remarks and examples. Tests developed so far assume that the student has already been taught the points being tested, but there is no reason why the header should not contain new material (providing it is not too complex), which might then be reinforced in the subsequent question answer routine. Additionally, the header may give the student information regarding other tests in a series.

A test may consist of up to 50 questions but in practice 20-30 is usually enough to cope with. Any sort of question is possible: gap-filling exercises, those requiring single word or whole sentence answers, questions to which there is more than one possible answer, questions in any language. Each question may occupy up to 4 lines of typescripts (note a line is 72 characters long, including blanks, on most terminals). These 4 lines could be expanded to say 5 or 6, but 4 seems sufficient for the time being. Within these 4 lines there may be explanatory comments, eg 'Note the feminine singular is required in this question' or 'The next 5 questions require you to convert nouns into pronouns'. The answer area in the data file allows for a maximum of 4 lines of typescript. These 4 lines may be used in different ways: each line may contain one of a maximum of 4 alternative answers or various comments to follow correct or incorrect student responses to questions (see below). These 4 lines seem sufficient at present, but expansion is easy, if required.

The program breaks up the test into blocks of any size the teacher chooses (10 is often convenient, but any figure is possible providing it remains constant for the whole of any single test) and each question, including comments if attached, is presented to the student, who then types in his answer at the keyboard (not forgetting the RETURN key). If he does not know the answer he simply types 'X'.

If he is right he is told so and may be congratulated. Congratulatory comments or reinforcement comments conveying additional information for the student which follow correct student responses are stored in the answer area in the data file and distinguished from answers by their prefix ' ', eg ' Good, that was a hard one!' or ' Note that fahren is also used transitively – Herr Fuchs faehrt Auto'.

If the student gives a wrong answer he is immediately told what the correct answer should be (the first, where alternatives are stored). At this point a commiseratory comment may appear or an explanation as to how the correct answer is arrived at. Comments to follow incorrect responses are prefixed by a dash, eg '– Bad luck, see the section on the genitive in the notes to this test'.



At the end of each block the student is given his score. If he answers more than 3 questions incorrectly he is automatically offered notes to assist him, which he can accept or refuse. These notes may also be summoned at any stage during the test by typing 'H' (ie HELP') instead of an answer. After the help notes have been presented, or if the student refuses the offer, a remedial rerun is immediately initiated whereby any unattempted or incorrectly answered questions are presented again. Any comments accompanying questions which are not required to be repeated on reruns (eg 'Note the next 5 questions refer to feminine adjective forms') may be suppressed by prefixing the comment line in the data file with a dash (–). Remedial reruns continue until the student scores full marks. This is to encourage the learner not to leave the keyboard until he has given at least one correct answer to each question.

The process may be compared with what frequently happens in the language laboratory, where the student may plough gaily through a dozen drills, understand none of them and get them all wrong – unless of course the teacher is at hand to cut in. The computer never tires of monitoring and correcting.

Having completed a block, the student may go on to try another if he wishes, and so on until the test is completed. Should the student get completely bogged down

If a student realises that he has clearly chosen an unsuitable test or is already 10 minutes late for a lecture he can type SOS in reply to any test question. This opens the escape hatch and lifts him safely out of the current block. He can then refuse further questions and quit the test program. Too brutal tactics could prove very irritating, so this facility at least leaves the learner some options open.

If a student continually gets questions wrong he is encouraged to keep trying but is also reminded that he can quit the block by using the SOS facility. If he perseveres, help notes are then automatically presented and a remedial rerun is initiated, going over what he has covered up to that point. This prevents reruns becoming too long. Once all the blocks in a test have been completed, a new test is offered, which the student can accept or refuse. Ideally we would like to build in some sort of intelligent branching procedure at this stage, whereby the computer offers progressively more difficult tests or, in the case of the weaker student, a series of back up or remedial tests. This is all within the capability of the computer, but requires much more research.

When a student finishes his session on GDTEST he is given his score, expressed as the percentage of correct answers out of all questions presented. This is nearly always sufficiently high to encourage him to come back for more.

During the course of each test the computer makes a record of the student's performance, storing details of which tests were attempted, how many attempts were made at each question, whether the test was abandoned before completion etc. A program has already been written to read from these records and produce individual student profiles, which may, if desired, be handed to the students concerned. Work is also in progress on programs to produce group profiles and test profiles. This should aid error analysis and reveal shortcomings in badly designed tests.

At present files are created in the EDITOR, which can be a bit tricky for the inexperienced user, so beginners are advised to seek help from someone familiar with the EDITOR. Tuition can of course be provided by our team, subject to time and demand. Work is in progress on a program designed to facilitate test creation and make the whole process idiot proof. This will be released once we are satisfied that we have a test structure to suit all tastes.

Two multiple-choice test programs

A second type of test program – GDMULT – was developed from an existing program written by Ray Garnett. It is a traditional multiple-choice test in fact. Students go on line as above and run the program GDMULT. They are offered a choice of tests. Having selected their test, students are then asked a series of questions to which there are 4 possible answers – A, B, C or D. A test may consist of up to 30 questions altogether (usually sufficient to cope with). Setting up this test is very easy. Data files are created in the EDITOR, as for GDTEST. Each question may consist of a maximum of 115 characters, including blanks. Each of the 4 alternative answers is also subject to this limitation. Thus the layout of a typical question plus alternative answers looks like this:

Question
Correct answer
Alternative wrong answer
Alternative wrong answer
Alternative wrong answer

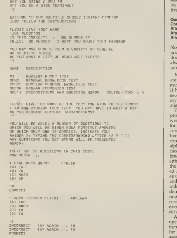
Note that the correct answer always appears immediately after the question. This does not, however, mean that answer A is always the correct one, as the program jumbles the answers randomly.

When the program runs, the questions are presented in turn, the student being invited to select from alternatives A-D. If he gives a wrong answer he may try a second, third and fourth time if necessary. At the end of the test these incorrectly answered questions are presented again.

This is where the clever bit occurs: the program then jumbles the alternative answers once more, thus making it pointless for a student to remember, say, that the correct answer to question 7 was alternative A. He must attempt to remember the content of the answer rather than its alphabetical designator. A student cannot escape from a test until he has given first time correct answers to *all* questions, either on the first or subsequent runs. At the end of the test a score is given, expressed as the percentage of first time correct answers out of all questions presented, and the time taken to complete the test is indicated. The computer stores the student's result and then offers a new test. If a new test is accepted, then the process described above starts again. GDMULT is excellent for short questions and very useful as a speed exercise.

A third testing program has been developed by John Muir. This is again a traditional multiple-choiced test, but designed for use outside computer workrooms, away from interactive terminals.

Questions and alternative answers are



```
 RUN
ARE YOU USING A VDU ?N
ARE YOU ON A WIDE TERMINAL?
?Y

WELCOME TO OUR MULTIPLE CHOICE TESTING PROGRAM
JUST FOLLOW THE INSTRUCTIONS !

PLEASE GIVE YOUR NAME
?JOE BLOGGS
IS THIS CORRECT? .-  JOE BLOGGS ?Y
HELLO, JOE BLOGGS   I HOPE YOU ENJOY THIS PROGRAM

YOU MAY NOW CHOOSE FROM A VARIETY OF GENERAL
OR SPECIFIC TESTS
DO YOU WANT A LIST OF AVAILABLE TESTS?
?Y

NAME   DESCRIPTION

NI     NURSERY RHYME TEST
GEN2   GENERAL KNOWLEDGE TEST
RUSS1  RUSSIAN GENERAL KNOWLEDGE TEST
GECON  GERMAN ECONOMICS TEST
DMCT1  PREPOSITIONS AND QUESTION WORDS   DEUTSCH BOOK 1 4


PLEASE GIVE THE NAME OF THE TEST YOU WISH TO TRY ?DMCT1
I AM NOW STORING YOUR TEST  YOU MAY HAVE TO WAIT A BIT
DO YOU REQUIRE FURTHER INSTRUCTIONS?
?Y

YOU WILL BE ASKED A NUMBER OF QUESTIONS TO
WHICH YOU WILL BE GIVEN FOUR POSSIBLE ANSWERS
OF WHICH ONLY ONE IS CORRECT, INDICATE YOUR
ANSWER BY TYPING THE CORRESPONDING LETTER (A B C D)
ANY QUESTIONS YOU GET WRONG WILL BE PRESENTED
AGAIN,

THERE ARE 10 QUESTIONS IN THIS TEST.
NOW BEGIN  ,,

I FRAU BERG WOHNT      BERLIN
(A) INS
(B) IN
(C) NACH
(D) IM

?D
CORRECT

7 HERR FISCHER FLIEGT     AUSLAND
(A) INS
(B) NACH
(C) IM
(D) IN

?B
INCORRECT   TRY AGAIN ,,. ?D
INCORRECT   TRY AGAIN ,,. ?A
CORRECT
```

A small extract from sample run of the multiple choice test 'GDMULT' set out on sheets of paper and handed out to students in class. Each student also receives a computer-readable card. On this card he marks in black pencil little slots corresponding to the questions and the alternative answers he considers correct. He adds his initials for identification purposes at the far right of the card and simply hands in the completed card to the teacher. The cards are then fed into the computer, together with a master card prepared previously, against which all the student cards are checked. The master card is accompanied by a parameter card on which information relating to the number of questions (maximum 35) and the number of alternative answers is indicated. The resulting output from the computer is in the form of a list of all students taking the test, with an indication of the questions they got wrong, their mark expressed as a percentage, and a group profile showing which questions the group as a whole answered correctly or incorrectly.

This is a very flexible test. Up to 9 alternative answers to each question may be given, providing this figure is constant within each test. It is a particularly useful test if large numbers of students are involved. Additionally, there is no need for all students taking the test to be present in the same room at the same time.

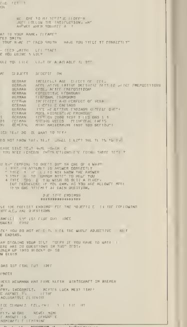
Conclusions

This, then, is where we have arrived so far in the sphere of CAL at Ealing College of Higher Education in the teaching of modern languages. Students who have acted as guinea pigs in trying out the programs have generally been very positive in their reaction to the application of new technology to language learning. So far we have developed only a trial set of programs and data files. Ideally, we hope to write a complete package of language tests and drills to be used at all levels. What we have used on the Prime 300 is equally applicable to microcomputers, of which increasing use is being made (lamentably mainly in the scientific sphere) in schools and FE colleges. If our package can be adapted for use on a microcomputer it would soon reach a wider audience. It would be nice to be able to say that Ealing will be at the forefront of language teaching by microcomputer, in the same way that we spearheaded the movement towards language laboratories in the 1960s, but it is mainly a lack of financial support which is holding things up at present.

The scope for new developments is enormous. So far we have only begun to scrape the surface, and it is painfully clear that we lag behind the USA in CAL by almost a decade. Linking a tape-recorder to a microcomputer is a future possibility, facilitating dictation tests or aural comprehension tests. More sophisticated remedial and guidance procedures within programs would ensure that no student attempts anything way beyond his ability and that all errors are backed up by branching to appropriate advice and further testing.

At least one company has begun work on the computerised language laboratory. This is not merely a dream of the future, as work on voice input and output is already at an advanced stage. It will almost certainly not be long before the voice in the language laboratory headphones stops its inexorable, unsympathetic rambling and says "I'm sorry, I didn't quite catch that. Let's try that last block of questions again." ■

Graham Davies is a lecturer at the Ealing [illegible] of Higher Education



```
           LOGIN A C1
ALCI    [illegible]  13 11 1E310

OK, LEARTF
GO
 LFME  FET   T
 RUN

          WE   ONE TO MY TESTING LIBRARY
          JUST FOLLOW THE INSTRUCTIONS AND
          ANSWER WHEN YOU SEE A  !

WHAT IS YOUR NAME, PLEASE?
!FRED SMITH
SO YOUR NAME IS FRED SMITH   HAVE YOU TYPED IT CORRECTLY?
!
OK FRED SMITH   LET START
ARE YOU USING A VDU?
!N
WOULD YOU LIKE   LIST OF AVAILABLE TESTS
 Y

NAME   SUBJECT   DESCRIPTION

G1     GERMAN    IMPERFECT AND  PERFECT OF  VERB
G2     GERMAN    ACCUSATIVE DATIVE DEFINITE ARTICLES AFTER PREPOSITIONS
G3     GERMAN    CASES AFTER PREPOSITIONS
G4     GERMAN    POSSESSIVE PRONOUNS
G5     GERMAN    PERSONAL PRONOUNS
G6     GERMAN    IMPERFECT AND PERFECT OF VERB
G7     GERMAN     ADJECTIVE ENDINGS
G8     GERMAN    MORE ADJECTIVE ENDINGS (HARDER ONES)
G9     GERMAN    MORE POSSESSIVE PRONOUNS
GT1    GERMAN    TEST ON 2000 TEST 1 LES ONS 1 4
GVB1   GERMAN    STRONG VERBS   PRINCIPAL PARTS
GEN1   GENERAL   MINI MASTERMIND (NOT TOO SERIOUS)

WHICH TEST DO  OU WANT TO TRY?
 !
I DO NOT KNOW THIS TEST  SHALL I LIST THE TESTS AGAIN?
 N
PLEASE GIVE TEST NAME AGAIN  G
DO YOU NEED GENERAL INSTRUCTIONS FOR TAKING THESE TESTS?


 OU MAY RESPOND TO QUESTIONS IN ONE OF 4 WAYS
    1 TYPE  N ATTEMPT TO ANSWER CORRECTLY
    2 TYPE  ?  IF  U DO NOT KNOW THE ANSWER
    3 TYPE  H  TO  UMMON NOTES TO HELP YOU
    4 TYPE  QQQ  IF YOU WISH TO QUIT A BLOCK,
      BUT PERSEVERE IF YOU CAN, AS YOU ARE ALLOWED MORE
      THAN ONE ATTEMPT AT EACH QUESTION.

                   ADJECTIVE ENDINGS
                  ****************

GIVE THE CORRECT ENDINGS FOR THE ADJECTIVES IN THE FOLLOWING
 SENTENCES AND QUESTIONS

EXAMPLE|  DAS IST EINE GUT  IDEE
ANSWER:   GUTE

NOTE: YOU DO NOT NEED TO TYPE THE WHOLE ADJECTIVE   JUST
THE ENDING.

I AM STORING YOUR TEST  SORRY IF YOU HAVE TO WAIT  !
THERE ARE 20 QUESTIONS IN THIS TEST,
BROKEN UP INTO BLOCKS OF 10
NOW BEGIN


1 DAS IST EINE GUT  IDEE
!E
CORRECT

2 HERR NEUMANN HAT EINE KLEIN  WIRTSCHAFT IN BREMEN
!EN
SORRY, INCORRECT.   BETTER LUCK NEXT TIME!
THE ANSWER IS      E THE
  ACCUSATIVE FEMININE

3 DIE SCHWARZ  FEL [illegible]
 ER
SORRY, WRONG   NEVER MIND
THE ANSWER IS     SCHWARZE
  NOMINATIVE FEMININE
```

A small extract from 'CDTEST', the main testing program.

NEWBURY NEWBURY NEW

Smart Micro-based Visual Display Terminals

24 lines of
80 characters
per line 96 ISO/ASCII
character set Dual Interface
CCITT V24 and 20/60 mA
current loop Selectable half or full
duplex Green phosphor non glare display

7000

Hard copy print out
Numeric pad
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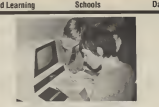


MICROCOMPUTERS IN ENGLISH TEACHING

David Hawthorne is Head of English at Butlers Court Middle School, B[illegible]

The development of the Microcomputer has reached the stage where English teachers can no longer regard its use as the sole monopoly of the Science departments. Language teachers must now respond to the implications of this new technology.

In this article these implications are considered primarily in the context of the Middle and Junior schools in which a large part of the curriculum is allocated to the teaching of language skills. Here English as a subject occupies an important position in the timetable, although other languages are taught.

For many years teachers have been using a number of technological aids to enrich the pupils' learning process and they have had to adapt their styles of teaching in order to use these aids successfully. The benefits, however, which machines can offer, are sometimes diminished by practical problems inherent in the technology. For example, television is now established in most schools; teachers regard it as a powerful means of conveying information to their pupils and particularly for its capability to put life into a subject which is remote from the personal experiences of the pupils. It is inflexible, however, in the sense that educational programmes are transmitted at fixed times during the school-day. The wider use of video tape recorders will eventually remove this particular restriction but meanwhile teachers have to structure their timetables around appointed viewing times.

That whole schools have adapted themselves in this way is striking evidence of the commitment of teachers to a technology which they believe is of great value to their pupils' learning. The really important influence underlying this commitment is that the broadcasters have developed educational programmes (ie the software) of a high professional standard and supported by follow up material of excellent quality.

The micro-computer, like television, offers new opportunities for the teacher. An increasing number of schools are being encouraged by their educational authorities to commit themselves to its introduction, especially in its most obvious application to the science disciplines and computer studies. In some areas, however, authorities have been lethargic and individual schools, and sometimes individual teachers, have had to proceed on their own.

The teething pains can be severe. There is as yet no national agreement on the standardisation of hardware nor is there a consensus on the computer languages most suited to educational needs. The software is often written by individual teachers to suit their own computers and access to other programs and exchange of software is extremely difficult. Unlike television there are no large organisations outside the teaching profession producing suitable software of a high professional standard.

This situation is, of course, due to the rapid development of the microcomputer. Teachers have had to discover for themselves what it can bring to education and have had also to identify its limitations. This article hopes to help practising teachers to identify the ways in which microcomputers might be used in the classroom across the full range of subject disciplines. Knowing what one is talking about is useful when dealing with the local education

BENEFITS OF AIDS TO TEACHERS IN DEVELOPMENT OF WRITING SKILLS

Aids / Activities	Books	Black Board	Duplicated Work Sheets and Work Cards	Radio	Tape Recorders	Record Players	Television	Overhead Projector	Micro Computer
Spelling	High	High	Medium	Low	Low	Low	Medium	Low	High
Vocabulary	High	Medium	Medium	High	High	High	Medium	Low	Medium
Grammar	High	High	Medium	Low	Low	Low	Low	Low	High
Writing Exercises	Medium	Low	High	Medium	Medium	Medium	Low	Low	Low
Comprehension and Language Appreciation	Medium	Low	High	High	High	High	Low	Low	Medium

Fig. 1

authority

The Teaching Environment

There are some fairly obvious situations in which the microcomputer will improve the effectiveness of English teaching For example in remedial teaching individual pupils with the help of the trained remedial teacher can be greatly assisted to improve their command of language by encouraging their interest in learning through a series of word games

In the classroom each pupil can interact with the computer through the use of question samples produced by the computer in the form of print-outs which the pupil fills in and returns for marking This frees the teacher from the tedious and often unproductive task of correcting the children s papers Furthermore the computer programs can be structured to identify the pupil's weakness in a certain area of learning and can then supply further practice questions to help reinforce his comprehension Similarly the program can provide an easy means of illustrating and demonstrating a wide variety of detailed learning points

A substantial number of schools particularly Junior schools contain mixed ability classes – that is ones which are not streamed into groups of compatible abilities In such classes it is necessary to have several different groups working at various levels and there is no doubt that the computer could help in the organisation of the work of these groups

Finally, there are occasions when the teacher brings the whole class together to learn a particular rule and to illustrate general applications

Developing Skills

The skills which the teacher of English tries to develop can be broadly divided into four categories

Reading Writing Talking Listening

Underlying all of these is the need to learn conventions and rules of grammar vocabulary and spelling, and to broaden experience in comprehension expression and communication The respective value of the aids available to the teacher for the development of one of these skills is illustrated in Fig 1 As an example tape recorders and radios are very useful as a means of illustrating the subtleties of the spoken word

The microcomputer can complement existing teaching aids in a number of ways provided that the software clearly meets the teacher's requirements One of the major criticisms of the text book is that it allows the teacher little freedom in the structuring of lessons The computer s big advantage over other teaching aids is that it can permit the teacher to *control* the software In the writing of any program therefore, one of the most important criteria to bear in mind is that the teacher using it will require as much flexibility as possible This point can be illustrated by reference to the methods and practice employed in one approach to the teaching of spelling

A requirement of any spelling program is visual repetition of the word and its components The teacher wants the class to see a word as frequently as possible, both in its entirety and broken down into syllables because this greatly assists the pupil to understand and mentally retain the construction of the word

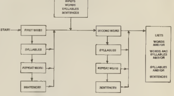
A simple spelling program could be structured as follows

A word is displayed on the screen eg ,

TRANSPARENT

Using simple key commands the teacher then shows the class how the word breaks down into syllables

TRANS – PAR — ENT



STRUCTURE FOR A SPELLING PROGRAMME

FIG 2

The word is then illustrated in the context of a sentence

THE GLASS WAS TRANSPARENT
I COULD SEE THROUGH IT

The teacher will now wish to supply the class with further uses of the word and perhaps to input a sentence or alternative words similar in meaning suggested by the class This repeated emphasis on the visual use of words and particularly on those suggested by the children themselves is important because it motivates pupils to comprehend the meaning and hence encourages them to use new words

Having gone through this series of displays for the word TRANSPARENT the teacher will proceed to the next word in the program and repeat the exercise At the end of the program the teacher should have a number of options available such as

- Display the words as a list
- Display the words complete and broken down into syllables
- Display the syllables only
- Display a selection of sentences [illegible] some of those which the teacher [illegible] have added during the [illegible] program
- Have the class copy the [illegible] own exercise books
- Simply memorise the word [illegible] the display in preparation for a test
- After a test (not necessarily held on the same day) recall the words for display so that pupils can mark and correct their own work

Thus the teacher needs to have an input facility at virtually every stage of the program – see Fig 2 For example a pupil may be asked to spell the word Transparent before it appears on the screen The teacher or the pupil needs to be able to input the attempted answer and the computer should respond with a visual reward or a sentence containing the correct spelling

Hardware

The above outline of the type of program which teachers might wish to have available gives some pointers to the conditions which the hardware will need to satisfy

Cost

Ideally each classroom should have its own microcomputer Unfortunately systems which would meet the software requirements are still expensive and the accompanying costs of software may put computers beyond the reach of many schools particularly Junior schools already hit by reductions in capitation allowances Nevertheless each school ought to be equipped with at least one computer so that the teaching staff can obtain practical experience in using it in the classroom situation and so be in a position to feed requirements back to the manufacturers and programmers

Portability

In order to overcome the cost limitations it is sometimes suggested that microcom puters should be moved from one classroom to another However, not all microcomputers are light enough for teachers to carry and it is not always practical to use trolleys

Clarity of Display

Pupils must be able to read the displays without strain Whereas mapped screens can be used to enlarge symbols in mathematics or displays of pictorial information, sentences require a line length of at least forty characters Consequently monitor screens will need to be large and sited at suitable focal points in a way similar to the positioning of the blackboard

Speed of Response

Much has been said about the microcomputer's ability to process and display information quickly However in the type of lesson described above the words should sometimes appear letter by letter, quite slowly The formation of words as the teacher writes them on the blackboard provides a guessing game which both holds the interest of the class and is in itself of educational benefit

Reliability

It goes without saying that the equipment should not break down during a lesson and that teachers should not be able to crash the program

Convenience

The equipment must be simple to set up and convenient for the teacher to operate Many teachers prefer to stand whilst teaching and would not wish to sit behind a VDU in order to see the display or input commands it should therefore be possible to swivel and tilt the VDU The VDU should be separated from the keyboard

Flexibility

The more flexible microcomputers are in terms of teacher machine interaction the more the teacher will use them and gain the substantial benefits which they can provide Ideally, the teacher would like to be able to stop the program at any point for questions or discussion *recall* at will and *bypass* sections of program In the type of spelling program illustrated here the teacher will not want a string of sentences coming up on the screen if he is only dealing with syllables Most important is the capability of breaking into a program to insert information or descriptions which arise during the lesson and which need to be repeated – as in spelling tests – on later occasions

Teachers do not have time to write programs any more than they have the time to write their own text-books What they need, therefore is program modules which they can readily assemble into less on texts prior to the lesson and a simple way of interacting with the program during the teaching session Even this will require the acquisition of new skills and this raises the crucial question of – who will teach the teachers? For some years to come it may be the teachers themselves but they will need the backing of their educational authorities organisations to build up the necessary pool of experience and software In particular there is a need for in service courses in programming for non mathematics teachers

This article has concentrated upon the teachers needs in terms of using a micro computer as an aid to the class teaching of English Other subjects in the Humanities such as Geography and History may offer easier tasks for teachers and programmers to tackle In particular the linking of microcomputers to language laboratories could provide pupils with a new dimension to audio learning

It would be ironic if the only way in which the necessary funds for software can be raised is by using microcomputers in the Independent Colleges which specialise in the teaching of English as a Foreign Language when it is schools which are under pressure to increase the effectiveness of their teaching methods ■

● *The author is organising a newsletter for Primary and Middle School users in order to share information and experience and would welcome any contributions from teachers The address to write to is David Hawthorne River Cottage The Riverside Bourne End Bucks SL8 5EB*

INTERFACE

The Software Solution

We all know that a computer system is only as good as the software and that much of the applications software hitherto available has proved to be the weak link Written in Microsoft basic for use with CP/M based hardware, Interface Software is probably the most comprehensive and robust application software currently available, which really will transform your microcomputer into an effective problem solving tool

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- Pascal 8 (UCDS) Interpreter
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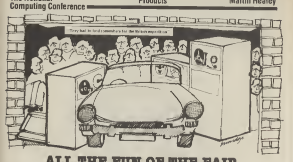
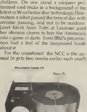

They had to find somewhere for the British expedition

ALL THE FUN OF THE FAIR

Is it really any coincidence that this year's U S National Computing Conference was held alongside Disneyland? The "rides" in Disneyland are bigger cheaper and probably better engineered, both however, are Mecca for children of all ages, particularly grown up children. On one stand a conjurer performed card tricks to a background of the latest in Winchester disc technology, Datamation s robot passed the time of day with anyone passing, and not to be outdone Janet Meek from Tubs at Leicester used her obvious charm to lure the Americans into a game of darts Even IBM's presentation had a feel of the fairground booth about it

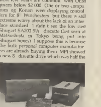
For the uninitiated the NCC is the annual (it gets two weeks earlier each year!) bun fight of the American and therefore the world s computer industry held this year in Anaheim California It moves about the U S last year in New York next year in Chicago Mainly for the professional the NCC has for the last few years featured a Personal Computer appendage which *itself* is on the professional side Endless papers are read in numerous multiple sessions with proceedings inches thick Annually, leading lights in the industry give keynote addresses saying exactly what you expected them to say To me however the NCC is the exhibition not the conference Every name in the book plus many others are there on show — or are they? Why did Burroughs pull out this year? Who is that little company in the corner – Honeywell? Nevertheless nearly 80 000 visitors piled through the vast exhibition halls during the four days of the show

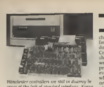


The star that wasn t there at the show Shugart 5¼ Winchester disc

The main exhibition centre halls house the bulk of the exhibits, but this year even the garage was pressed into service – they had to find somewhere for the British expedition The Personal Computer exhibition plus a big overflow finished up in the Disneyland Hotel tastefully decorated in the way only Mini Mouse can (ugh!) linked with the main exhibition by a free coach service (Fun buses to you)

Amidst all this delightful and quite irresistible turmoil all the latest products were on show, and the computer industry on show is worth seeing I suppose the only revolutionary new product to be found was Al Shugart's 6 MByte 5¼" Winchester disc drive Plenty of 8" Winchesters about in production too, not prototype, and a number of cartridge tape back up systems Corvus showed their Mirror system which uses a domestic video recorder as a Winchester back up device However Memorex and CDC (Control Data Corporation) may have pulled the rug out before they can yet walk because both exhibited 8" Winchester disc drives with a fixed disc and a removable cartridge a solution favoured with older cartridge discs The CDC Lark was only 10 + 10 MByte but the Memorex was over 20 MByte Targets of 100 MByte for 8" Winchesters within the next few years are common with OEM prices below $2 000 One or two companies eg Konan were displaying controllers for 8" Winchesters but there is still extreme worry about the lack of an interface standard I didn t see the low cost Shugart SA200 5¼" discette (last seen at Matsushita in Tokyo being put into Shugart boxes) I suppose this is because the bulk personal computer manufacturers are already buying them MPI showed a new 8" discette drive which was half the

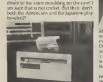

Konan s HARDTAPE (tm) subsystem Winchester disc drives and cartridge tape back up



Winchester controllers are still in disarray because of the lack of standard interfaces. Konan Corporation offer a solution for SMD interface-

height of an SA800, most interesting.

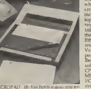
There were numerous VDUs on display ranging from dumb terminals to programmable devices. Nothing new appeared however and Pencom's VDU, although on display in the non prominent area, was probably one of the best. There were a large number of advanced graphics terminals and systems, mostly using colour. IBM showed a colour VDU to good effect. I feel sure colour graphics has a big place in conventional DP (Data Processing). The simpler colour systems based on T.V. videos displayed their usual unique features – similar to trying to read a newspaper under water. The most unusual terminal, however, was shown by the Japanese marketing company C. Itoh in the form of a DEC VT100 look alike. When I say look-alike, I mean look alike even down to the same moulding for the case! I am sure that is not cricket. But then don't both the Americans and the Japanese play baseball?



ONYX C800 [illegible] system use Zilog Z8000 based architecture and has a built-in Winchester type hard disk, cartridge tape drive for back up and up to 512 KBytes of memory

The colour was in the printers as well. Quite a few (IBM again, in the vanguard) were matrix printers with multi-colour ribbons. Normally the colour will only be changed per character but with some fancy software with control down to the dot level, good pictures were on display. Centronics talked about (but did not show) their "hand writing" printer which will by-pass daisy wheel printers in their product range. Diablo stole a march, however, it introduced a new cheaper daisy wheel printer. Slightly slower than the old one, it can be switched to use metal or plastic wheels. Both parallel (not compatible with the old one) and serial interfaces are standard and print formatting, including justification, are included. Surely this design will be the norm in personal computer based word processors, not surprising then, but showing great initiative Diablo had an additional stand in the Personal exhibition. I only hope this will start a price cutting war. Data Products, by the way, were the only major printer manufacturer noticeable by their absence.

Bubble stores are still waiting to burst into the computer scene. Findex offer an option, but why not the floppy disc version?



MICROPAD [illegible] hand written data entry terminal a first [illegible] in the USA

On the personal computer front Commodore showed the new 80 column system and previewed an 8" floppy disc drive add-on. But Apple stole the show by giving free tickets to Disneyland. They also introduced the Apple III. Nothing much to get excited about, despite a 20-page press release which said nothing – it is a nice product in the normal line of progression. Despite speculation it still uses a 6502, but with extra logic to expand the address space (96KB is standard). The new packaging now incorporates one 5¼" floppy, surprisingly still single side, single density. Some good software (a new operating system and Visicalc) is thrown in with the price. The video monitor is also included, monochrome, enhanced to 80 columns. Microsoft also showed a plug in card for older Apples which supports a Z80 CPU and therefore can run CP/M. When initialised the card forces the normal 6502 into a hold state and runs off the far more powerful Z80. It is constrained due to integrated ROM to a maximum 48KB CP/M system, which could give some problems with FORTRAN etc.

Is this a DEC VT100? Does someone at DEC need spelling lessons? No, C. Itoh have had the VIT to make a complete look alike.

One of the most interesting long term features of this year's NCC was the introduction of *networks* for local microcomputers. Xerox demonstrated an Ethernet connection as expected, but Zilog pulled a fast one on me with Z NET. Using a 600K baud coax bus, Zilog have developed a bus interconnect module, priced at about $900, which links into their new small computers via a special port. The Z NET release includes a layered software product on top of the RIO operating system to allow systems on the bus to communicate. Details of the protocol were not available but I think it is a contention protocol similar to Ethernet. It was introduced by a "top-hat and tights and little else girl" straight from Vaudeville, who covered all technical aspects from A to B, but with style. Digital Research also showed CP/NET, a new software product for linking a hierarchy of CP/M systems into a master CP/M (or MP/M) system using conventional serial I/O. Dynabyte were demonstrating the system to some effect. Micromation had a variant on the theme linked by a common S100 bus rather than I/O ports.

The new Apple III [illegible] includes [illegible] 12 inch video monitor

My final thoughts on this year's NCC are my personal embarrassment of repeatedly trying to explain the misspelling of Cardiff U.K. on my name badge as CALDIFFUK and poor old Nixdorf who had introduced a personality module in their hand held translator for 'Olympic Facts'. Roll on Chicago. ■

[illegible]

[illegible]

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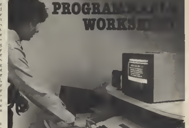
INCORPORATING A YEAR ROUND DISPLAY OF MICROCOMPUTERS IN ACTION

VISICALC

Martin Beer



VISICALC is an example of a new type of program package to be marketed for microcomputers We have become used to both systems and application programs being offered for sale in this country but as yet there have been very few applications packages' which allow the user to solve his own individual problems without the necessity of learning how to program his computer This is very important now that microcomputers are reliable and cheap enough for executives and businessmen who are not computing enthusiasts to consider how they can be of use The current market for packages for such things as Ledgers Stock Control, and other applications with a potentially wide user base has helped considerably — so long as you wish to use your computer for one of these jobs Otherwise it is usually necessary to find someone to write the necessary programs, or to write them oneself

The problem is intended to present the user with a programmable work-sheet on which to lay out his problem The worksheet is divided into a grid of rows and columns At each intersection a alphanumeric title, a number, or a formula can be placed Not only does VISICALC remember the formula but when any item is changed all entries which depend on that value are updated automatically This saves a lot of time and effort in recalculation when working with data which is heavily interrelated It is therefore easy either to work out a series of interrelated problems, or to try out a number of possible alternatives before selecting the most suitable Once a problem has been entered into the computer, the effect of various possible alternatives can be discovered very simply by changing a single entry This makes VISICALC very useful to forecasters, and others who have to make decisions on rapidly changing data

The APPLE screen acts as a window through which the user can view this work-sheet This window moves automatically, so as to always display the area around the current cursor position Thus different sections of the work-sheet are displayed by moving the cursor to the required place This is very easy to visualise and with very little practice any information of interest can be found quite easily If as is often the case the items of interest are in separate sections of the work-sheet the screen can be split in two either horizontally, or vertically so that both areas can be displayed The two windows can be set to scroll together when the cursor is moved or individually as required Moving the cursor from one window to the other is accomplished with a single keystroke Also displayed along the top of the screen the cursor the current line entry and how much memory is still free This information forms a block at the top of the display screen

FIRST IMPRESSIONS

To run the version of VISICALC under review an APPLE II, or an APPLE II Plus with at least 32k of random access memory and at least one disc drive is required A suitable printer can be interfaced using the usual APPLE interface cards

The program comes on a write protected discette in a neat padded brown folder together with a well written and presented instruction manual A reference card, and the usual registration forms are also included in the package which costs £96 00 + VAT

VISICALC is booted directly from the discette provided, after loading the BASICS discette, if your system has the Language Card installed A blank worksheet is displayed immediately The program is then ready for use The user has the option of starting to work on a problem directly, or of loading a sheet back into memory after having been stored on a discette during a previous run It is therefore possible to store the current work sheet at the end of a session and to restore it when the user wishes to continue Probably more important is the ability to store skeleton work sheets which can be loaded quickly at the start of a session, after which the data required can be entered into the relevant position very quickly

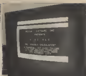
The manual is comprehensive taking the new user through setting up his APPLE and starting up and loading VISICALC. A full description of how to do this for the various varieties of APPLE that are or have been sold is included a very important point for the new APPLE owner, who may well have bought his machine specifically to run VISICALC The method of initializing new data discettes is also described in this section so that the user is provided with all the information he requires before he starts to use VISICALC

Incidentally data discettes which are initialized using VISICALC can be used to store other DOS 3 2 files, but cannot be used to boot DOS into the computer The rest of the manual is divided into four Lessons dealing with the various facilities the program offers Starting from Lesson 1 the user is introduced to the basic commands and operations which are necessary to make full use of the package This, together with the introduction the new users should read carefully before attempting to use the program

USING THE PACKAGE

Lesson I deals with the simple operations required to control the package such as moving the cursor around the worksheet, correcting errors, and setting out simple calculations It is written in tutorial form, and should be read with the computer available as instructions are given, at every stage, to run the examples described in the text. This is very useful when initially introduced to the package but I found it a little difficult occasionally to follow the operation of the more complex commands when trying to use them for myself from this description and the necessarily terse comments on the reference card A clearly written reference section would be very useful

The left and right arrow keys are used to control the movement of the cursor Since there are no up and down arrow keys on the APPLE keyboard these two keys are used to move it in both the horizontal and



Screen Credits

vertical directions. The current direction is displayed at the top right-hand corner of the screen, and is changed by pressing the space bar. Whilst four direction keys would be easier to use, the method adopted seems a reasonable compromise considering the constraints of the APPLE keyboard. Since the right-arrow key is used for cursor movement it cannot be used for its usual purpose, backing up to correct typing errors. This is done using the ESCAPE key. To anyone used to the normal use of APPLE keys this can be a little disconcerting, but the new user who is not preconditioned by other software should have no problem.

The purpose of an entry is determined by its initial character, which is displayed on the edit lines at the top of the screen. After the initial letter has been recognised by the computer, a suitable prompt appears immediately above this line which (hopefully) reminds the user of the various options now open to him. Some of these are quite long lists of possible command characters, so it is advisable to have the reference card available as an additional prompt until you are completely familiar with the system.

Commands which could have catastrophic effects if entered accidentally, such as clearing the current work sheet, require confirmation before the requested action is taken. This is well done, since most cases leading to catastrophic damage are protected in this way, but there is no feeling of having to enter everything twice, as there is on some overprotected systems. It is possible, however, to accidentally overwrite whatever is at the current cursor position if, for instance, an incorrect key is pressed at an awkward point in a command sequence, and the error beep from the APPLE is not noticed immediately.

Commands to VISICALC are always preceeded by a / and are entered by pressing a single letter key on the keyboard. In many cases there are a number of different options available, and these are entered with a further range of command letters. In most cases the user will soon remember the complete sequence of keystrokes as one command. The commands available are given in Table 1. There is one command which does not follow this pattern, probably because the designers felt that it would be used so frequently that a single keystroke is required. This is the

VISICALC

Go To command which instructs the cursor to move to a given grid position. This command is entered by typing a > at the beginning of the line. This took a little getting used to, but since nothing can be overwritten, no real damage can occur.

Text is entered on the work-sheet very simply, by moving the cursor to the required text position and then typing the required character string, which must start with a letter. When the cursor is moved on, the text entered will appear at the desired position on the work sheet. Numbers can be entered either directly or by reference to the contents of another grid position, in which case the value stored there is placed in the current cursor position. If another grid position is to be referenced a + sign must be placed before the first character (e.g. +B10) otherwise the computer will assume that you intended to put text there.

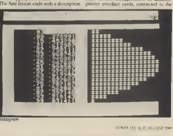
It is, of course, also possible to enter formulä which are to be calculated at any grid position. These can include constants (e.g. 75+25) or references to the contents of other grid positions (e.g. 75*A2 or +A1+A2). The great power of VISICALC is that the computer remembers which entries depend on any given grid position and when the contents of that position are changed the computer automatically recalculates all the others, thus saving a considerable amount of work and eliminating many possible mistakes. A number of common functions are available for use in formulä (see Table 2).

One feature that experienced computer (and programmable calculator users) will find lacking is some form of conditional evaluation. This may be a nuisance in some applications but, in general, is unlikely to cause many problems. There is a feature which calculates the value of the current expression and displays it immediately (by pressing the ! key) so that the user can see what is happening and take appropriate action.

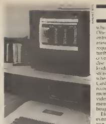
The first lesson ends with a description of how to save data files on discette, after initialization if necessary. A very good account is given of the reasons why backup copies of valuable data must be taken, since discettes cannot be considered to be a permanent recording medium. Unfortunately no information is given about how to obtain backup copies of the program discette and, indeed, all of the usual methods of copying discettes failed to provide working copies. The only way of ensuring that the program is always available would therefore appear to be the purchase of several packages. Since your data files are only of any use so long as the program is available to access them, long-term use of VISICALC could prove very expensive.

The second lesson covers replicating formulä over a number of grid positions, and further useful features, such as varying the character width of the various column entries. I found the replicating feature rather difficult to use at first, but once I had understood the way in which it worked, something which was not made very clear in the manual, it proved to be a very useful facility. Using it, quite complex worksheets could be organised very rapidly and later modifications applied equally simply. This is very important since often the original layout will prove defective after a certain amount of use.

The last two lessons expand on the facilities introduced in the first two and introduce such things as format specifications, splitting the screen into two halves, printing out the whole or part of the worksheet, and the addition and deletion of complete rows and columns from the work-sheet. The operation of the various built-in functions is also explained in some detail. It is in these sections that the true power of a package of this sort is displayed, and some of its limitations. Whilst it is possible to insert and delete complete rows and columns, it is not possible to swap, or sort them. On the other hand, considerable attention has obviously been given to the novice; the operation of the print command probably appears to be unnecessarily complex, but it did work with several configurations of different printer interface cards, connected to the



A histogram



The Programmable Worksheet

APPLE by way of all the available interface slots It should therefore be possible to run VISICALC on almost any possible configuration of APPLE without difficulty This means that it should be compatible with any other software which you buy or write, to use on your machine

CONCLUSIONS

This is a package which appears to be worthy of the average Apple owner's consideration The sales literature stresses its use in financial forecasting which is presumably the use for which it was originally developed but it has uses far beyond that admittedly somewhat limited area Engineers are likely to find its arithmetic capabilities somewhat limited if they attempt to use it for complex calculations but there are still many jobs for which it is ideal I used it, for instance to check that the power supply of a new system would not be overloaded when using various combinations of processor memory and peripheral cards It took considerably less time than my usual method with a programmable pocket calculator Laying out the worksheet took very little longer than programming the calculator and laying out the necessry tables The basic structure of the worksheet is now stored on disc and can be recalled almost instantly should I need to perform the same task in the future

The work-sheet has space for a matrix of 60x254 entries which should be adequate for most applications The overall memory available may however prove a limiting factor but I never managed to use more than a small fraction of the space available even when developing some quite complex calculations I did however find that I could run out of memory by replicating a complex formula over every entry in several rows This was only a test and the time taken to recalculate all the entries precludes I would have thought the use of a microcomputer in any real application which required this sort of complexity One possible problem area is that even if entries which are no longer needed are erased from the screen the storage required for them is not available for further use This space can only be recovered by saving the current sheet on disc clearing the whole sheet, and reloading it Since the deleted entries are not stored space for them is not reallocated when the sheet is reloaded If a Language Card is fitted to your APPLE VISICALC recognises the extra random-access memory available and uses it This provides a worth-while increase in the memory space but would be expensive if bought simply for that purpose

I found it impossible to crash VISICALC even though it was given every justification This is of course, a very good feature since the inexperienced user would be discouraged very rapidly if the program needed to be reloaded at the slightest mistake If on the other hand the program either tells him what is wrong or allows him to correct it before disaster strikes his confidence in computers increases rapidly Apart from a propensity for overwriting entries occasionally if a command is mistyped VISICALC is very good in that respect. Those commands which are not reversible such as clearing the work sheet, ask for confirmation before they are executed For the rest, it is usually a simple matter to reinstate the lost entry This very rapidly gives the user confidence in the capabilities of his computer

My main criticism remains the fact that I *could not make security copies* of the program discette The manual makes the point quite rightly, that discettes are not an infinitely reliable medium and several copies of data files should be made The same comments apply to the program discette If it is scratched or damaged in some other way the data is locked away until a replacement discette is obtained, which may well take some time

Whenever I purchase a program discette I normally take a copy and lock the original safely away, where it cannot be damaged so that if anything happens to my working copy I can replace it very quickly It should always be remembered that this sort of program is going to appeal mainly to newcomers to microcomputers who are likely to treat media with a lot less respect than those who know exactly how fragile these items are They are also likely to become disenchanted when programs refuse obstinately to load and not have the patience to wait for a replacement to be sent from their dealer, or, worse still, America The market in this country is still far too fragile for this sort of discouragement Senior executives are already being told by their Data-Processing departments that microcomputers are inherently too unreliable to be of any real use as anything other than sophisticated games playing machines, and the loss of a program discette, without an immediate backup at a crucial time would be seized on eagerly to prove the point

It is easy to criticize a package of this

TABLE 1 THE VISICALC COMMANDS

/B	Sets an entry to blank. Doesn't take effect unless you follow it with ←→ or RETURN Does not affect /F formats set at the entry
/C	Clears the screen sets all entries to blank resets formats windows titles etc. VisiCalc will wait for you to type a Y to confirm that you indeed want to erase all entries
/D	Deletes the row (/DR) or column (/DC) on which the cursor lies
/F	Sets the display format of an entry to one of the following formats general (/FG) integer (/FI) dollars and cents (/F$) left or right justified (/FL or /FR) or graph (/F*)
/FD	Resets an entry to use the global default format instead of an explicit format set with a /F command
/GC	Sets the column width Requests a number from 3 to 37 end with RETURN The column width can be changed on a per window basis
GF/	Sets the global default format that determines the display format of all entries without explicit format settings sets with a /F command Requests one of the same display formats used by the /F command The global default format is a per window setting
/GO	Sets the order of recalculation to be down the columns starting at entry A1 (/GOC) or across the rows starting at entry A1 (/GOR)
/GR	Sets recalculation to be automatic (/GRA) or manual (/GRM) You can always cause a manual recalculation of all entries by pressing the ! key
/I	Inserts a row (/IR) or column (/IC) just above or to the left of the row or column on which the cursor lies
/M	Moves an entire row or column to a new position Prompts you to move the cursor from the row or column which you want to move to the destination row or column just before which the entries moved should reappear End with RETURN
/P	Print command
/R	Replicate command
/S	Storage command
/T	Sets a horizontal title area (/TH) a vertical title area (/TV) sets both a horizontal and vertical title area (/TB) or resets the window to have *no* title areas (/TN)
/V	Displays VisiCalc's version number on the prompt line The version number will disappear as soon as you type something else
/W	Window control Splits the screen into two windows at the cursor position (/WH for horizontal /WV for vertical) or returns the screen to one window (/W1) Windows may be synchronized (/WS) or returned to unsynchronized (/WU)
/	Repeating label Requests the contents of a label entry end with ←→ or RETURN The contents of the label will be repeated over and over to fill the entry no matter what the column width

type for what it does not do. The main omissions in this case are the lack of any form of sorting capability except by manually swapping the necessary rows or columns (a very time consuming process), and the ability to define your own functions. The extensive repeat facility goes a long way to make up for the lack of the second but I still felt the need for some programming facility, particularly when I had accidentally overwritten a complicated expression and had to reinstate it from scratch. These features would however be expensive — both in storage required, and execution time — to add, and so would result in significant degradation in other parts of the package. The authors were therefore probably right when they decided to omit them.

This sort of package is essential if microcomputers are to become a part of everyday business life. Busy managers, executives and engineers are not going to have time to learn how to program their computers. They are also going to find the average pre-programmed application package too restricting for their use. Mainframe and Mini computers are already provided with packages which allow the user to specify his problem in terms that *he* or *she* is used to, and the computer does the rest. Of course, a special package is required for each group of users, but if that group is large enough, it is well worth while developing them. ■

Acknowledgement

The author would like to thank Personal Computers Limited for the loan of the VISICALC package to write this review and to the various members of their staff who offered help, and suggestions as to how it could be used.

Editor's Note The VISICALC package is now also available on the CBM PET.

TABLE 2 BUILT-IN FUNCTIONS

@SUM *(list)*	Calculates the sum of the values in *list*
@MIN *(list)*	Calculates the minimum value in *list*
@MAX *(list)*	Calculates the maximum value in *list*
@COUNT *(list)*	Results in the number of non blank entries in *list*. Maximum number of entries in the list is 255
@AVERAGE *(list)*	Calculates the average of the non-blank values in *list*. Maximum number of entries in the list is 255
@NPV *(dr range)*	Calculates the net present value of the cash flows in *range* discounted at the rate specified by expression *dr*. The first entry in the range is the cash flow at the end of the first period, the second entry is the cash flow at the end of the second period etc.
@LOOK UP *(v range)*	Compares the value *v* to the values of successive entries in *range* and selects a corresponding value from the column or row immediately to the right or below the entries in *range* as the result of the function. The values in *range* are normally in ascending order and the result is the value corresponding to the last entry in *range* that is less than or equal to *v* before an entry greater than *v* is found. If the first entry in *range* is greater than *v* the result of the function is NA
@NA	Results in a Not Available value that makes all expressions using the value display as NA.
@ERROR	Results in an Error value that makes all expressions using the value display as ERROR
@PI	Results in 3.1415926536
@ABS *(v)*	Results in the absolute value of *v*
@INT *(v)*	Results in the integer portion of *v*
@EXP *(v)* **@SQRT** *(v)* **@LN** *(v)* **@LOG10** *(v)* **@SIN** *(v)* **@ASIN** *(v)* **@COS** *(v)* **@ACOS** *(v)* **@TAN** *(v)* **@ATAN** *(v)*	Calculates the appropriate function. The trigonometric calculations are done in radians

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HANDLING THE REAL WORLD

The first part of a two part article on computer modelling and simulation gives a general introduction to the subject. The next article will deal more particularly with the role of the computer in this field.

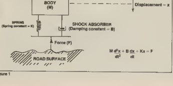
The idea of using a model in order to extract and focus the essential features of a particular situation is familiar from many aspects of everyday life. For example, in order to make an unfamiliar journey by road from X to Y we might commonly employ a map as a model to represent the important details of the intervening terrain, and a task such as this is more easily accomplished if we can experiment on the model (by looking at possible alternative routes and noting the desirable and undesirable features of each) than if we try to find the best route by driving along a randomly selected road in the hope of a successful conclusion.

In other situations modelling is more of a necessity than a mere convenience. If the designer of a guided missile were to test his initial design by launching an actual physical device, the consequences might be disastrous. The design criteria must be validated in some way before the experiments with a real world system are an acceptable risk. Alternatively, an engineer might need to discover the limits within which the parameters of a nuclear reactor can be allowed to vary before a critical point is reached. This could be carried out in a small and highly constrained experimental system, but in a nuclear power station at full working capacity there may be practical constraints which were not taken into account in the idealised prototype. Even with a potentially less dangerous system such as a motor car design, the direct implementation of a sub-unit may be very expensive in terms of financial outlay or time involved, particularly if successive refinements are likely to be required.

These and many other examples point to the need for modelling or simulation techniques. The principal aim of system simulation is to derive and formalise a representation of a system in which all the relationships and interactions among the components of the simulated system are preserved and in which the consequences of manipulating variables may be reproduced.

Models can occur in a variety of forms. A physical model, for example, may consist of an actual scaled-down version of some system on which experiments may be carried out in a way which is directly related to the ultimate operational conditions of the original, while a mathematical model may embody all the parameters of a physical system but itself have no distinct physical existence whatsoever. Herein lies a principal feature of simulation and modelling techniques, which is that the precise mechanisms which are used to model the features of a system need have no direct correspondence to the mechanisms by which those features are actually produced in the system itself.

Not surprisingly, the use of the digital computer as an aid to the modelling process has been increasingly exploited and currently represents the major medium through which system simulation is achieved. This article will introduce and examine the basic concepts of simulation and will be followed later by an article which examines some particular techniques and applications in greater detail.



MASS OF CAR BODY (M)
Displacement – x
SPRING (Spring constant = K)
SHOCK ABSORBER (Damping constant = B)
Force (F)
ROAD SURFACE
$M\frac{d^2x}{dt^2} + B\frac{dx}{dt} + Kx = F$

Figure 1

System classification

Systems may be classified in a number of different ways. A useful and frequently adopted distinction between system types can, however, be made on the basis of the nature of the variables of the system. This distinction is best illustrated by introducing two examples briefly.

Example 1 Consider a simplified representation of a car suspension (see Figure 1). It is a relatively simple matter to derive a mathematical model which shows the displacement of the car body (and therefore its passengers!) over a period of time as a result of the application of some disturbance such as a bump in the road. In this case the variables of the roblem such as displacement, velocity, and so on can vary over a continuous range of values, and the overall situation may be modelled in a mathematical way by means of the simple differential equation shown.

This model could be used to plot the displacement against time for a variety of disturbances which might occur in order to find the combination of shock-absorber and spring characteristics which would give the most comfortable ride.

Such a system, in which the parameters of importance are continuously variable, is generally referred to as a *continuous system*.

Example 2 A contrasting example is to consider modelling the way in which traffic movements occur around a road junction. The object of such a simulation might be to identify an appropriate sequence and timing of traffic light changes to minimise delays and avoid undue traffic congestion at strategic points in a busy part of town.

The variables involved here may be regarded in various ways, but it is clear that a significant event is represented by the arrival of a car on a particular arm of the junction (as it passes a pressure-sensor in the road, for example).

In this example, since a car is either present at the junction or not, the variables of the problem vary in definite and discontinuous steps. A system of this sort is normally referred to as a *discrete system*.

(Incidentally, note that the distinction between continuous and discrete systems is not always absolutely clear, and may depend upon the particular aspect of the system which is of special interest to the modeller. Can you think of an example?)

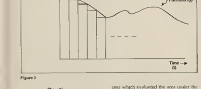


Figure 2

Continuous System Simulation

A large proportion of continuous systems are reducible to a model which may be specified in mathematical form as a set of differential equations – the system equations. By solving these equations the parameters of interest may be identified and monitored as their values change with time. While some equations may be solved analytically to provide a general solution, in cases where this is not feasible the automatic solving of the system equations must be carried out by suitable computational circuitry.

One method for the simulation of such systems involves representing physical variables by *analogues*. For example, a variable voltage may be used to represent distance or velocity, the magnitude of the analogue quantity being in direct proportion to the actual value of that parameter in the physical system. Circuitry may then be designed to carry out electronically all the operations required to simulate a solution to a differential equation. Techniques such as these, involving analogue computing devices, are less widely used than in the past because of the increasing convenience of the application of digital machines to similar problems.

In the application of a digital computer to the simulation of continuous systems, therefore, the major problem to be overcome is the matter of the integration of a function in order to represent the time course of the solution of a differential equation. Although a variety of approaches is possible, most techniques are derived from or refinements of a basic idea which arises from the observation that an integral of a function may be evaluated by measuring the area under the curve which represents that function.

The area under the curve of Figure 2, therefore, can be approximated by measuring the value of the function at regular intervals of time and summing the values so obtained over the required interval of integration. We can imagine, then, a process which evaluated the area under the curve by summing together all the components in the form of rectangular strips as shown in the example. Of course, the value obtained in this way is an approximation, but the accuracy can be improved by taking an increasing number of samples into consideration, or by adopting more refined computational techniques (such as Runge-Kutta methods).

Simulations of continuous systems may be written in standard programming languages such as FORTRAN or ALGOL with the integration routines written as subroutines. It is possible and more convenient, however, to utilise special purpose languages (called Continuous System Simulation Languages, or CSSLs) which are oriented specifically towards simulation. In such languages, derivatives may be represented directly as variables (eg. X or DER X). Examples of CSSLs are CSMP III (Continuous System Modelling Program) and BEDSOCS, a BASIC-related language developed at Bradford University.

Discrete System Simulation

The nature of discrete systems is such that significant changes in their parameters and variables of interest occur only at certain well-defined instants of time. Thus, it is particularly important to have knowledge of the set of numbers or variable values which define the characteristics of the system at any time. For example, in the road junction model referred to earlier, in order to simulate traffic flow and plan a sequence of controlling traffic signals, we would need to represent the number of cars on each junction approach at any particular time. These variables – the state variables – define the instantaneous behaviour of a system, and the pattern of change which they undergo characterises its behaviour over a period of time. An *event* in the system then corresponds to some action which causes a change in one or more of these state variables.

Since a most important aim of a simulation is generally to monitor the progress of changes in the modelled system, it is necessary to establish a convenient method for the representation of time as a variable. It is customary to represent time by a number which is incremented at specific intervals, and the simulation process is therefore said to be governed by a 'clock'. When referring to time in a simulation, therefore, we are usually talking about a variable within the computer program rather then the physical time taken by the computer to carry out its computations. Another valuable feature of simulation, of course, is that the time scale of the simulated model need not correspond exactly to time in the physical system, and modelled reactions and interactions may therefore conveniently be speeded up or slowed down in order to improve efficiency.

The updating of the time parameter may be governed in two different ways. In the *unit advance* approach the clock variable is incremented at regular unit time intervals

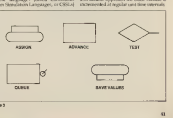


Figure 3

After each increment the system is checked to see if any change in state variables is due to occur and the appropriate action taken Although a very thorough and easily applied technique, if events occur infrequently by comparison with the clock frequency so that there are many time intervals where no event occurs this method can be inefficient in terms of computing time

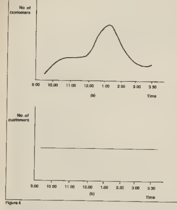


Figure 4

An alternative approach is simply to advance the clock to the next time at which an event is due to happen so that a list of pairs (Event A, Time A), (Event B, Time B) is produced. In choosing to update the clock in this way we are adopting the *event time advance* approach

As with the simulation of continuous systems, special-purpose languages have been developed to aid the efficient writing of complex simulation packages For example, GPSS (General Purpose Simulation System) is a language which defines a close correspondence between executable statements and a set of standardised flowchart blocks which can be used to represent the system to be simulated (some examples are given in Figure 3)

Other simulation languages are more conventionally structured and rather more general-purpose in nature For example, the language SIMSCRIPT allows the definition of concepts such as *entities attributes, event routines* and so on while SIMULA is essentially an extended version of ALGOL with additional facilities oriented towards simulation processes

Finally, two other topics must briefly be mentioned to conclude this introductory survey of simulation techniques First the simulation of many physical systems requires the introduction of stochastic processes It may often be necessary therefore to provide a means of generating a series of random variables which because of the requirements of the specific problem under investigation must occur with a specified distribution of values The arrival of customers at a bank counter for example is much more likely to occur with the distribution approximated by the curve of Figure 4 (a) than that of Figure 4 (b) Many established computer-based algorithms are available for the generation of random variables

Second it is clear that many simulation situations occur with common features For example the idea of a queue of items waiting for attention by a limited number of operators forms the basis of a large number of physical processes ranging from the simulation of customer flow in a supermarket to the assessment of the efficiency of a computer installation where equipment failures must be dealt with by a limited number of technical staff A general queuing model is illustrated in Figure 5 In cases such as these simulation may sometimes be unnecessary because of the existence of analytic solutions to a given range of problems developed from the mathematical concepts of *queuing theory* Many real problems however fall outside the range of situations for which queuing theory can provide a mathematically tractable solution and thus investigation through computer simulation rather than analytical techniques is necessary ■

- *Dr Mike Fairhurst is at the Electronics Laboratories the University of Kent at Canterbury*

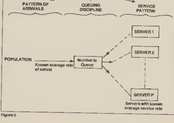

MAIN FEATURES OF A QUEUING SYSTEM
PATTERN OF ARRIVALS
QUEUING DISCIPLINE
SERVICE PATTERN
POPULATION
Known average rate of arrival
Number in Queue
SERVER 1
SERVER 2
SERVER P
Servers with known average service rate

Figure 5

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(other CP/M™ machines supplied)

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HANDLING DATA

Part I: Serial File Processing

This series specially commissioned from the author is for everyone who has a knowledge of the rudiments of programming The algorithms written Pascal style are very easy to follow Dr Darrel Ince is at the Faculty of Mathematics the Open University

In this series of articles I hope to introduce you to the field of commercial data processing a field evidenced by the large number of advertisements for COBOL programmers in the computing press, a field in which a large number of computer staff is involved The series of articles are designed such that each can be read in isolation together with the first few paragraphs of this article

The first question that needs to be answered is, what is data processing?

There have been many definitions, the most popular definition is that data processing is concerned with the maintenance of files with keeping files up to date and accurate

A file is a collection of records Each record contains data about some object this could be an employee in a company, a spare part in a warehouse or a library book in a computerised library system

A record consists of individual items of data which describe the object that the record refers to

In the library example where a computerised system may be used to keep track of book borrowings the library would keep a **file** of book **records** Each record would correspond to a book and would contain *pieces of data* such as the *name* of the book its *serial number* *who* is currently borrowing it and *when* it is due back

Each piece of data in a record is known as a **field** In the diagram (Fig 1) we can say that a library book record contains a *title* field, a *borrower* field, a *serial number* ('ser no) field and a *due back* field In general, a field can contain integers sequences of alphabetic characters sequences of alphanumeric characters or real numbers In the library example the title field of a library book would contain alphanumeric characters since some books Catch 22' for example contain numbers The borrower field of a library book record would contain alphabetical characters while the ser no field would contain integers

A file which is more orientated towards commercial applications is one which is used in calculating employees salaries for their company Typical fields that would occur in an employee record are an employee's name works number tax code tax deducted this financial year department and salary (see Fig 2)

In the employee file example that I have used there is one special field this is the works no (number) field The contents of this field *uniquely* identifies a record since no two employees have the same works number Such a field is called the **key** field

Files occur in almost every commercial application of computers and data processing is concerned with their maintenance This consists of

1. The *deletion* of records from files This might occur in the employee file when a worker leaves the company

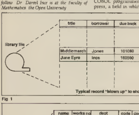


Fig 1

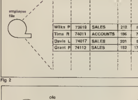


Fig 2

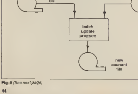


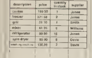
Fig 6 *(See next page)*

2. The addition of records to files This might occur in the library file when a new book is bought for the library
3. The *modification* of fields in a record This would occur in the library file when a book is borrowed The borrower and due back fields of the library book record corresponding to the book borrowed would then have to be modified In the commercial example, in the employee file the deducted field of all the records would have to be modified monthly
4. The *retrieval* of data from files Although strictly this shouldn t be included under the category of maintenance I have done so for completeness Data may be retrieved from one record in a file in response to a query such as who borrowed Wuthering Heights? or data may be retrieved from a number of records in response to a query such as how many books are borrowed by Smith?'

The first type of file that I shall describe is known as a **sequential** file Such a file has the property that it is ordered on (arranged in some definite way) according to its **key** field This key field can be either an integer alphabetic or alphanumeric field Thus if we had an application where a file of kitchen equipment was maintained in a warehouse, it would be ordered on the *name* of each item of equipment (see Fig 3)

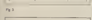
If the warehouse stocked more than one *type* of cooker then the description fields would have to contain a fuller description eg GEC Cooker Model 10 to ensure that this field was kept a key field

The main property of a sequential file is that one can only retrieve a record after reading through *all* the records that precede it in the file It is impossible to access a record directly



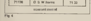
description	price	quantity in stock	supplier
cooker	189 50	7	Jones
freezer	171 58	2	Jones
grill	31 10	1	Smith
mixer	41 35	6	Williams
refrigerator	99 90	15	Jones
spin dryer	85 90	8	Davis
washing machine	130.99	3	Davis

Fig 3



accno	name	balance
71136	C S Williams	71 33

Fig 4



accno	amount
71136	17 24

Fig 5

Sequential files were once very important in the early days of computing where the only file storage device available was the magnetic tape unit where physical constraint prevented records being accessed directly

With the advent of devices such as the moving head disc unit which does enable records to be accessed directly, sequential files have become less important They do however provide an efficient method of storage where file maintenance operations may occur at specified intervals With the employee file example, such operations would occur monthly Sequential files also provide a better form of security when files may be destroyed accidentally They are not useful when a record has to be deleted modified or retrieved within a short time An airline booking system would not use a sequential file as the search for a record may take minutes, during which time a large queue could have built up File structures which enable a much more rapid response will be described in later articles of this series

Given the property of a sequential file the problem is to maintain that file as effi-

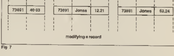


Fig 7

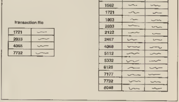


Fig 8

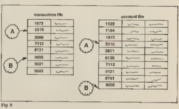


Fig 9

ciently as possible. Instructions describing the maintenance procedure to be carried out are normally contained in another file called a **transaction** file. After a period all the changes or transactions on a file are collected from source documents; the transaction file is *produced* from these documents and is *then* used to maintain the sequential file. This process is sometimes known as batch processing or batch updating, the name being derived from the batching of transactions together in the preparing of the transaction file.

In order to describe the process involved in batch updating, I shall concentrate on a simple example. This is of a building society or bank which keeps a file of accounts. I shall further simplify the problem so that an account record (Fig. 4) contains only three fields representing the account number, the name of the borrower and the current balance, the field labelled accno being the key field. This is quite a simplification. In a practical environment, an account record would contain many more fields; the address of the account holder and his overdraft limit are two that readily come to mind.

In order to simplify the application even further, I shall, at first, assume that the only maintenance operation that is applied is a change in the value of the balance field. The transaction records (Fig. 5) in the *transaction* file will then consist of an account number and a transaction amount.

The transaction file will be created from forms collected from the building society or bank counter clerks and punched up by data preparation staff. The transaction amount could be positive, in which case it would be treated as a credit, or negative, in which case it would be treated as a debit.

Thus, in the example above, £17.24 would be subtracted from the balance field of the record corresponding to account number 71138. When a sequential file is processed and the transactions are applied, a new account file is produced by the batch update program. (See Fig. 6 on previous page.)

When a transaction record corresponding to an account record is encountered by the update program, then the balance field of the account record is modified and it is written to the new account file (see Fig. 7).

One way that the update program can modify a sequential file is to *read* a transaction record, *keep reading* account records until it *finds* the record corresponding to the transaction record, and *then modify* it. It would then read the next transaction record, start at the beginning of the account file and keep reading account records until it again encounters an account record corresponding to that new transaction record. It would keep doing this until it had finished reading all the transaction records. If the transaction file contained 200 records then this would mean that the account file would have to be reread 200 times. This seems very inefficient.

A better way to organise the update is to *sort* the transaction file on (according to) the field corresponding to the key field in the account file. We can see how more efficient our update becomes by reference to the diagram below (see Fig. 8). This shows a transaction file and a small account file. Note that the transaction file has already been sorted, in this case according to account number, in ascending order.

The first transaction record is read (1721); the account file is then read record by record until the record with a key of 1721 is found; this is the third record; the account record is then updated.

The next transaction record is read (203[illegible]) and the account file is read from the *third* record until a record corresponding to this transaction record is encountered. This process is repeated until the transaction file has been fully read. You can see that the account file has only been read once.

I shall describe this algorithm in an in

```
read a record from the transaction file putting it in transrec
read a record from the account file putting it in accountrec
while the end of the transaction file hasn't occurred  do
   begin
   if transrec. accno = accountrec. accno then
      begin
      (*  found the corresponding account record
      accountrec balance = accountrec balance + transrec
      amount
      read a record from the transaction file putting it
      in transrec
      end
   else if transrec accno > accountrec accno  then
      begin
      (*  haven't found the corresponding accountrec yet   *)
      (*  copy the account record into the new account file*)
      (*  and read the next account record                 *)
      write accountrec into the new account file
      read a record from account file putting it in accountrec
      end
   end
(*  At this point the transaction file will be exhausted  *)
(*  however, there may be some records that haven't been  *)
(*  read left on the account file; copy these across      *)
(*  to the new account file                               *)
While the end of the account file hasn't occurred  do
   begin
   write accountrec into the new account file
   read a record from account file putting it into accountrec
   end
```

Fig A1

```
Read a record from the transaction file putting it in transrec
Read a record from the account file putting it in accountrec
While the end of the transaction file or the end of the
account file hasn't occurred  do
```

(See page 55 for continuation)

Fig A2

▶

BRAND NEWs

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9

This middle section may either be pulled out or photocopied then filed for reference It will be comprehensive and range over the whole field of products services events and courses **PU** stands for Personal User **SB** stands for small base – that is small budget or small business **MB** – medium base medium budget or medium business **BB** – big base big budget or big business **Addresses** are to be found at the end of **Brand News.**

Systems

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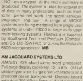

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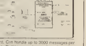

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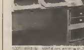

100[illegible] modular [illegible] with [illegible] MHz clock frequency includes [illegible] processor. Memory modules contain either 16 or 32 KBytes dynamic RAM organised as 1 or 2 switchable banks giving total machine memory in excess of 64 KBytes (eg 256 KBytes for an 8 user system). Disc controller interfaces up to 3 5¼ or 4 8 disc drives. DMA control module gives transfer speeds of 4 16 microsecs per byte in disc and 650 000 bytes/sec in memory to memory transfers. 4 port module provides asynchronous or synchronous interfacing for up to 4 independent peripherals. Full graphic b/w and semi graphic colour or b/w video display modules. I/O modules provide analogue and digital interfaces for process control and communication. DDE-developed MIKADOS operating system with monitor to allow co-operating sequential processes to communicate. Monitor also contains a scheduler. Subroutines exist for creating, renaming, extending and purging files on discs, and to read/write records in direct or sequential files. Three programming languages: Assembler, COMAL (structured superBASIC) and Pascal. Basic system consists of cabinet with power supply and 17 slot positions, one 5¼ disc drive storing 90 KBytes and following modules: CPU, Refresh module (for any number of) RAM modules, 32K RAM, Disc Controller. Also included CRT terminal with interconnecting cable, system disc containing os, dedicated single user COMAL interpreter and 4 formatted empty discs. Available packages include Sales Ledger, Purchase Ledger, Financial Book-keeping, Invoicing, Ordering, Parts List, Stock Control etc plus Process Control systems. **MB**

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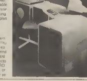
Cartridge drive microcomputer system. Comprises a series 3000 desk top or mini computer with 2 or 3 8 floppy disc drives, KB10 cartridge drive with 5MB of fixed and 5MB of removable disc, VDU and keyboard and a high speed printer. CAP micro products has completed implementation of its MICRO COBOL products in the multi user mode on this machine. In the one cartridge drive sys[illegible] [illegible] sales ledger [illegible] terminal make stock enquiries on another and retrieve data on a third simultaneously. The MICRO COBOL application range includes the auto Index and auto Clerk data management systems, sales, purchase and nominal ledger and payroll. System prices start at under £10 000 plus VAT. **SB MB**

GEEST COMPUTER SERVICES LTD

SYSTEM 80 PENSION FUND MANAGEMENT SYSTEM designed by United Pension Services (UPS) of Bristol. Designed to operate on Texas Instruments 990 series of computers. No special expertise is required on the part of the user who can be expected to take full advantage of system 80's comprehensive facilities with only a few hours familiarisation. Suitable for pension funds with memberships ranging from one or two thousand to ¾ million. A typical configuration suitable for a fund with up to 20 000 members would cost about £55 000. Prices start at around £31 000. Rental including the computer starts at £8 000 per annum. **MB BB**

HEWLETT—PACKARD

HP 250 Winchester disc based small business system. Fully sealed 12 1 megabyte winchester disc fits in console/desk replacing previous options for dual and triple flexible discs. Average seek time of new disk 70 milliseconds, max transfer rate 526 7 Kb per second. Single 1 2Mb floppy included for backup and data loading. Three new capabilities — larger add on memory (£11 720 per megabyte), intelligent network and RJE software for data communications to HP, IBM and other computer systems, and a new facility to read and write IBM 3741 — formatted flexible discs. New 128 Kb memory boards (£1 455 each) increase maximum memory available to 384 Kb in HP250 systems equipped with max 6 terminals. For max multi-user performance 250 allocates user memory in 32K or 64K partitions to each terminal. Plug in communications interface HP intelligent network processor INP/250 makes possible communication over switched or private telephone networks or over direct cable connections. With on board 16-bit HP SOS microprocessor having 32 Kb of its own memory the INP/250 frees HP250 of all line handling. RJE/250 software package forms user interface for 2780/3780 emulation as RJE terminal to mainframe. Full or half duplex RS[illegible]



Sy[illegible] [illegible] dealers are [illegible] on switched [illegible] lines) R[illegible] the INP/250 hardware [illegible] printer optional [illegible] includes a true data base [illegible] IMAGE) with query [illegible] **OEMS MB**

PRONTO ELECTRONIC SYSTEMS LTD

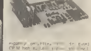
PASCAL MICROENGINE. Hardware implementation of Wirth's ideal pseudo machine. Assembly language is P code and PASCAL implementation is VCSD with VCSD operating system and screen editor. VCSD PASCAL is a slightly extended version of the Jensen and Wirth report. Microengines are available in various forms: chip set including flopo, disc controller and DMA controller; a single board with all necessary connections; single boxed board with power supply and fan cooling; and a boxed board with power supply and double sided single/double density floppy disc drives. Suitable terminals and printers also available. Microengine board has 64 KBytes of RAM, 2 serial ports, 2 8-bit parallel ports, floppy controller port, four phase clock generator, memory control including direct memory access controller, and the P code implementation of the 16 bit MC1600 processor. All common variants of floppy discs catered for. Software generated on Microengine is super portable — not only source files but compiled and linked code files can be down loaded to another processor running a VCSD interpreter. **PU OEMs**

SOUTHWEST TECHNICAL PRODUCTS (COMPUTERS) LTD

Microcomputer system for estate agents. Based on *SWTPC's 6800* family of microcomputers the software was developed by A B M S Ltd in conjunction with Brighton Estate Agents Field & Thomas. All accounting procedures for property management are handled (rent, rates, insurance, repair etc). A file is maintained on each property and the current situation may be screened at any time. Owner accounts and tenant statements are printed automatically at pre-selected intervals. Agent can produce own results at year end for tax purposes. **ESTATE AGENTS**

TRANSAM

TUSCAN S 100 microcomputer based on IEEE standard S100 bus, Z80 based. Offers an economical approach by utilising widely available S100 extension cards while starting the customer off with five S100 cards laid flat on one board. Powerful I O capability



expan[illegible] Files [illegible] based CP M high [illegible] synthesis. Packages [illegible] drives available as a kit [illegible] and tested. Also available [illegible] Transam system [illegible] including resident BASIC and PASCAL. From £195. **PU SB EDUCATIONAL**

Applications

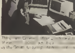
BRAND NEWs

AES WORDPLEX

RECORDS MANAGEMENT package for Wordplex stand alone word processing system 3 main programs SORT sorts automatically into alpha or numeric sequence in ascending or descending order from a given database and stores the result on discette EXTRACT extracts automatically any required information from a given database and stores the result on discette and REPORT reports from either a sort or an extract operation in the same or a different format In addition SUMS the Wordplex arithmetic package which is part of the new Wordplex Word Processing Programme performs addition subtraction multiplication d[illegible]ion remainder division and percentages **MB**

CITY COMPUTER SYSTEMS LTD

PMS (Portfolio Management System) and *DEALER GATEWAY* Both online systems intended to give the Dealers and Portfolio Managers in the City access to information to make the buy or sell decision PMS is an aid to efficiency for Portfolio Managers in Building Societies Pension Funds Trusts etc Dealer Gateway is a range of communications and electronic devices for instant access to worldwide money market information Dealer configures system to requirements using CCS s software and online databases including A P Dow Jones and Reuters Main interface for dealer is Sony T V which receives and displays Ceefax Oracle video in house Teletext systems and CCS s database information Using DEC PDP 11 for processing peripherals include Hewlett Packard 2648A graphics terminal and associated printer Links are available to Monotype 80 word and information processing systems which also produces telex tape Online linkage to the telex networks is also possible using Z80 microprocessor – up to 20 telex lines can be linked to 20 standard keyboards or to serial computer lines Input options include Quest Micropad for hand[illegible] written input **BB**



The [illegible]

COMPUTERPLAN

New (Release 2 0) *Multi Terminal Word Processing Package* for Data General Computer Systems Text editing formatting and printing system which will run concurrently with other Computerplan application packages for simultaneous data processing and word processing activities Release 2 allows concurrent editing and printing using multiple terminals and printers on DG microNOVA NOVA ECLIPSE and CS ranges Individual text files may be password protected and automatic deletion by purge date is provided as are column manipulation facilities Printing facilities include right [illegible] cent subscripts and superscripts and automatic avoidance of unsightly orphans and widows Line spacing specifiable System handles customised continuous or loose stationery All text files automatically catalogued Housekeeping utilities allow user to copy rename delete or freeze files display contents of catalogues and look at/amend print queue **OEMs, MB, BB (DG)**

COMPUTER SOLUTIONS

FORTH a structured programming language like Pascal but using the highly efficient Reverse Polish Notation Permits interactive programming Based around 32K RAM Intel SBC 8086 computer system with dual floppy disc drive Whole system including FORTH costs £7000 plus VAT FORTH can be purchased to bootstrap from PROM or disc for use in Motorola 6800/6809 Intel 8080 RCA 1802 Zilog ZDS TI9900 or PDP 11 for around £2400 **MB**

DATA GENERAL

Business BASIC now available for operation with Advanced Operating System (AOS) on whole range from microNOVA to ECLIPSE Features multiple keyed indexed sequential file access dynamic record allocation screen management common area direct block I/O and it then a[illegible] logic Business BASIC utility programs simplify program development optimise program size and offer the ability to sort files to build initialise and print invoices and to rebuild index files Also includes utilities for producing printed output for documentation purposes **MB (DG)**

DATA SCIENCES INTERNATIONAL LTD

GYPSY Garment Industry Production System System involves the production of traditional garment production tickets in optical character format on an ICL mini computer On subsequent completion of the work tickets are read by the mini which in association with one of DSI s Computer Centres produces reports on operator performance production progress line bottlenecks and calculates piece work earnings The system was produced with the aid of a grant from the Garment and Allied Trades Requirements Board **Garment Industry**

DATAVIEW

MICROCLERK for electronic filing and retrieval on CBM PET Can be used alone or in conjunction with WORDCRAFT word processing program Requires 32K PET with CBM Model 3040 disc drive Complete with manual and sample documents £159 plus VAT **PU, SB**

DIGITAL EQUIPMENT CORP

DEC Has released a new version of the DEC SYSTEM 20 Operating System *TOPS 20 Release 4 0* Among 23 enhancements are support of a PDP 11 based Remote Job Entry (RJE) station HASP multi leaving support and dynamic recognition of any disc and tape drives added to the system and features enabling administrators and operators to obtain increased productivity from the system In addition Reliability Availability and Maintainability Program (RAMP) features of TOPS 20 have been improved Also a more powerful version of the CTS 300 Operating System for the DEC Datasystem family of small business [illegible] has been introduced Has executed [illegible] at speeds up to 15 times faster than the previous version Designated *CTS 300 Version 6* the new system enables program development and debugging to be performed concurrently with applications activities Remote debugging can be performed if the remote system has 128 KBytes of memory or more **MB (DEC), OEMs**

FARS COMPUTER SERVICES LTD

FARS (Fixed Asset Registration System) embodies requirements of CCA (Current Cost Accounting) so that SSAP 16 recommendations are complied with (ie CCA instead of HCA (Historical Cost Accounting)) Maintains records of a company s assets integrating full CCA procedures with a range of depreciation techniques System runs in timesharing mode so ad hoc reports may be produced at any time Historical depreciation figures are maintained in parallel with CCA values Indices are maintained on file enabling an estimate to be made of the current replacement costs of assets on an industry to industry basis Users may build up their own private index file to generate their own cost estimates **Accountants**

HEWLETT-PACKARD

IML 3000 (Interactive Mainframe Link/3000) makes possible communication between HP 3000 Series II or III and IBM mainframes or others that use IBM software (Amdahl Intel or Magnuson) Via IML HP 3000 programs in COBOL FORTRAN BASIC or H P s Systems Programming Language (SPL) can pass data to or read data from application programs on the mainframe using CICS IBM DB/DC or TSO This is accomplished by a set of high level program statements (called intrinsics by H P) such as readscreen writescreen readfield and writefield where all low level screen decoding and translation is handled by IML IML/3000 also provides Inquiry and Development Facility (IDF) which allows HP 3000 terminals to be used almost exactly as IBM 3277 or 3278 Using IML/3000 and HP DSN Distributed Systems Network Architecture databases distributed across both computers are available online IML/3000 costs £2 051 plus £88 per month for support IML interfaces with the synchronous communication line via the recently introduced Intelligent Network Processor (INP) a microprocessor-based communications controller costing £2 637 A four day on site customer training and implementation package is also available **MB BB**

HOTEL MICROSYSTEMS

Enhancements to NORTH STAR system software Extra 80K per drive is available using *DOS40* providing 820K on a 2 drive quad HORIZON Modified BASIC provides extra functions for the commercial programmer System integrity is improved with the continuous *Automatic Memory Test DOS* Special versions of DOS and BASIC increase usable memory by over 11K to 80K System throughput can be increased using RAM printer spooler Multi user system provides each user with up to 56K RAM Printer and file lockout are incorporated in a special BASIC **SB MB (North Star)**

MARCOL COMPUTER SERVICES LTD

New extensions to *CHAMPS* (Computerised Hotel Accounting and Management Processing System) Range of available equipment now includes *DEC PDP* range from 11/23 to 11/70 CHAMPS now totally transportable without modification on DEC PDP family Data General ECLIPSE range and IBM Series

1 Programs enhanced to include integrated Sales Ledger and Invoicing System providing account control from reservation to final payment From around £30 000 for a six terminal system providing concurrent access to all programs and integrated Reservations Front Office Accounting and Sales Ledger **Hotels**

MICROSENSE

Sole UK distributors for Apple II new Apple *FORTRAN* Operates in the Apple Pascal Language System so same software development environment established for Pascal users is available FORTRAN takes full advantage of Apple's high resolution graphics sound and control paddles through Turtle graphics and Applestuff units Under Apple Language System FORTRAN Pascal and assembler routines can be created and integrated into a single program Prerequisites are 48K Apple II Plus Apple Language System Apple II Disc Drive video monitor and FORTRAN package (= 2 FORTRAN diskettes and reference manual)

TEXAS INSTRUMENTS

DX10 TPL brings terminal programming language from exclusive use on TI's small business systems to use on disc-based systems of the (larger) DS990 family Same forms development (TPL forms) and data processing capabilities (TPL procedures) are implemented on both versions of TPL Also supports an indexed file management system provides a large library of functional subroutines and implements a general purpose communications interface for RS 232C compatible devices DX10 TPL operates as a task in the DX10 multiuser multitask environment of DS990 Models 4 to 30 (providing a range of 128 KBytes to 2 million bytes of memory and from 9 4m to 677 9m bytes of formatted online disc storage DX10 also supports COBOL BASIC Pascal RPG II and FORTRAN Software license for DX10 TPL (with software copy on a DS10 disc) is £1 500 (inc software update and support) Renewals £450 **MB (TI), OEMs**

UCC

New version of *STEM* heat exchanger mechanical design program Version 3 0 Updated to cover ASME VIII Div 1 Summer 1979 Addendum and TEMA 6th Edition 1978 Developed in conjunction with the Computer Aided Design Centre (CADC) **Engineers**

Discs, Tapes, Punches, Readers

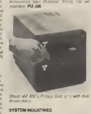
ROXBOROUGH ELECTRONICS LTD

FMC 100 Disc Type Magnetic Card Reader Reads and writes up to 8K of data on disc type magnetic media One track only used to record on a spiral path either one sector of 8 KBytes or two of 4 KBytes Data transfer speed 320 microsec per character providing read/write access time 4 sec per 8 KBytes Magnetic media enclosed in protective envelope Designed to interface with 8 bit micros Incorporates error status detection program to eliminate checking Operates in any plane uses direct drive brushless motor Requires 5 and 12V d c **PU SB**

SHARP ELECTRONICS (UK) LTD

Following launch of MZ 80K Personal Computer are shortly to introduce *Mini Floppy Disc Unit* Utilises dual standard 5¼ discs with 70K of memory on each side two units can be run together to [illegible] with a door [illegible] Sharp [illegible] that the MZ 80K is now fully equipped to enter the business market and [illegible] comprehensive computing capacity [illegible] smaller business or limited applications [illegible] larger organisations In addition a printer has been announced (see Printers) Prices not yet available **PU SB**

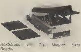
BRAND NEWs



Sharp MZ 80FS Floppy Disc Unit with dual driven discs.

SYSTEM INDUSTRIES

Has signed a marketing deal with FUJITSU to sell *Fujitsu Winchester Technology Disc Drives* in Europe Initially the 9762/9763 9764 series of non removable media moving arm disc storage drives providing 66 132 or 165 MBytes of unformatted storage respectively will be available They may be used for program and data storage and staging into the main memory of a system Data or programs may be loaded from discette drives tape drives cartridge drives storage module drives or communication lines The drives consist of a sealed disc enclosure rotary actuator spindle motor printed circuit boards and standard storage module interface Within the disc enclosure are the spindle discs heads and rotary actuator At rest, the heads are in contact with the disc surface in the landing zone As the spindle rotates the heads begin to fly over the surface of the disc Discs have coating to facilitate in contact start stop operation Dual heads on each access arm result in twin data bands and landing zones around disc surface Outer band of bottom surface of lowest disc is prewritten at the factory and contains servo track information read by the servo head to provide track positioning data clocking and generation of index and sector marks Inner band of lower surface is reserved for the fixed head option PCBs read write track follower servo and interface boards are housed immediately adjacent to the sealed disc assembly **OEM MB BB**



Roxborough [illegible] Type Magnetic [illegible] Reader

Printers

FACIT ADDO LTD

(Data Products Division [illegible] Family featuring Facit [illegible] 4526 80 and 132 column [illegible] journal roll as well as [illegible] and 150 c p s [illegible] true descenders [illegible] mechanism [illegible] processor [illegible] safety and interference [illegible] 232 and parallel interfaces [illegible] language versions current [illegible] including US ASCII **MB OEMs**

ROXBOROUGH

RP 1/4 Thermal Printer Up to 40 [illegible] per line standard width 20 [illegible] double width 80 [illegible] standard width 96 ASCII characters Inputs 8-bit parallel or serial [illegible] RS 232C Graphics images built up [illegible] 32 bytes per line for maximum [illegible] lines In video mode accepts [illegible] whose amplitude 1 0 3 0V peak to peak [illegible]

accepted building the image [illegible] dot format for full size and [illegible] format for half size [illegible] both graphics [illegible] mode image can be either [illegible] tive selectable by switch [illegible] clude video copy [illegible] print £28[illegible] **PU SB**

SHARP ELECTRONICS (UK) LTd

MZ 80P Matrix Dot Printer In company with MZ 80K Personal Computer Operating at [illegible] lines per second across 80 columns and prints all the standard alphanumerics [illegible] as a range of graphics Can also produce upper and lower case letters In addition a floppy disc unit has been announced (see Discs Tapes Punches and Readers) [illegible] **PU SB**

VDUs, Graphics, Terminals & Systems

BURR BROWN

TM25 data collection control and display terminal TM25 is a small unit which can be hand held or mounted in the [illegible] console of process controller or business system or even in the cab of a vehicle or mobile crane Comprises 8 digit numeric display numeric or hexadecimal keyboard with decimal point and minus keys seven function lights seven function keys a clear light and an enter key Includes both CCITT V24 (EIA RS 232C) and 20mA current loop interfaces as standard which are brought out to a 25 pin connector One such pin is used for the 15V power supply **Industrial**

CAVRI CORP

Computer Video [illegible] Integrator Enables user to index and [illegible] extensive series of videotape frames or segments or to interact with videotaped material. Also storage and retrieval of text and audio visual information and control of remote functions of VCR from keyboard and program. Access time to desired point on videotape generally less than 5 sec. Average time to find randomly distributed segments on 30 min cassette about 45 sec. Search accuracy + [illegible] frames or approx [illegible] sec. System comprises Apple I/O board cables and connectors system software in Applesoft BASIC on disc and user s manual. Available for VCR s carrying control pulse or interfacing with manufacturers search unit eg Sony Betamax and institutional quality Panasonic and JVC units. Also at lower price system with interactive video with sequential access using video play and pause modes only **PU**

HEWLETT-PACKARD

Five inch CRT Display offered as option with H-P 3075 and 3076 factory data capture terminals. Displays up to 2 pages of information – 1 page of 16 lines with 32 normal size characters per line and 1 page of 8 lines of 16 large characters. Anti-reflective screen £498 (H P data capture terminals offer choice of single line alphanumeric LED display a multi function reader of Type III punched badges punched or marked cards a Type V badge reader and a built in alphanumeric strip printer. Cost from £134 [illegible] to £3137 depending on options **MB**

H P [illegible] CRT Display on HP [illegible] 3076

IMAGE DATA PRODUCTS LTD

Image Data Tablet Digitising tablet capable of taking A4 or quarto sized paper which will recognise handprint recognition input accept drawings or sketches recognise handprinted mathematical problems and produce automatic solutions accept input through a teletype compatible touch table accept series of calculations through a calculator touch table accept coded entry to computer programs or security systems through a user selectable touch table key area. With a special pen shapes and characters may be drawn digitised and stored in an on or off line computer. Characters drawn are converted to ASCII code for transmission via an RS 232 C/V24 interface at rates up to 9600 baud. Character recognition software is in an associated microprocessor. A cluster of 7 tablets can be concentrated into an IMAGE DATA 8 microcomputer with disc storage or to use that microcomputer as a front end to any mainframe

BRAND NEWs

PENNY & GILES DATA RECORDERS LTD

Market *LEAR SIEGLER ADM 3A PLUS* big brother of ADM 3A. Upper and lower case characters making full 128 ASCII character set upper case keyboard lock numeric key pad cursor control keys unshifted rub key and a programme mode key to enable writing into display memory and displaying all control codes £562 **MB OEMs**

SCAN COMPUTERS LTD

Market *MICROPAD Hand Data Entry Terminal* Captures handwritten entries recognises and translates alpha numeric and special characters into machine readable form and feeds them direct to the computer. Gives user instant visual readout and errors can be corrected b[illegible]

MICROPAD Hand Data Entry Terminal

TDS

Whizzard 7250 Graphics System a new Megatek colour raster graphics system that provides about ten times the speed and performance of existing raster terminals while giving users of computer graphics all of the dynamic line drawing facilities found previously only in vector refresh systems. Incorporates a high speed digital vector generator that has an average pixel writing time of better than 160 nanoseconds – a speed which allows complex pictures to be updated and manipulated at the standard 30Hz frame rate on a 512 x 512 colour or black and white meter monitor screen. 7250 will support multiple monitor configurations with up to 4 red green and blue colour monitors with 16 colours each or up to 16 black and white monitors. Interfaces available for popular 16-bit minis and with 9600 baud serial asynchronous RS232 systems. System s hardware firmware and software compatible with Megatek s existing line or vector refresh systems. Option modules are also the same for both systems. In addition the intelligent peripheral control unit available for both systems makes use of 8085 to allow users to interact with graphic data on screen using keyboard joystick data tablet digitizer function switches control dials and digital comparators. System has up to 196 KBytes or 32-bit words vector memory each word holding up to 2 vectors or 4 characters four levels of subroutine nesting multiple vector definitions hardware character symbol generation and full memory segmentation capabilities. Black and white monitor systems from £17 000 colour from below £22 000 **OEMs**

TRANSAM

TRITON microcomputer provided the graphics on new album release The Unknown Soldier by Roy Harper. Both record centrepiece and album cover show TRITON graphics symbols and text. Computer typeface forges a link between the battleground of Verdun shown on album front [illegible] when [illegible]

Processor & Memory Boards, Chips, Programmers, Test Instruments, Modules, Training Aids.

CALCOMP

91x/92x Series of 4 on line/off line plotter controllers. Compatible with existing Model 907 on line plotter and off line plotting systems. All 4 drive Calcomp s full range of drum and belt bed pen plotters off line or on line switchable on line/off line mode. Controllers contain self test capabilities control panel includes English language message display. Host processor time save by controllers ability to internally generate lines (vectors) user defined dashed lines circles arcs and up to 480 characters and symbols (192 defined by user) all of which can be rotated and scaled. Off line features include automatic read error detection multiple search to file or address then plot facility and automatic tape wind and unload. Tape formats can be either 7 track NRZI 9 track NRZI or PE with optional universal version being available to allow switch selection. Prices from £7700 inc software **BS**

DIGITAL DEVICES LTD

Model UV8 high performance EPROM eraser developed by Microdata Computers Ltd. Employs very high intensity u v power source (254 nm). Solid state timer can be pre-set to expose EPROMs for 8 or 16 minutes at the end of which time an audio sound is emitted. Internal interlock switches u v source off whenever cabinet is opened for insertion or removal of EPROMs. Opening cabinet automatically zeros timer and closure automatically starts erasure sequence. 9mm conductive foam pad ensures that EPROMs are protected against damage from electrostatic charges. Two indicator lamps on front panel indicate power on and u v source energised £97 00 plus VAT

EMI SE LABS

Type 9620 High Speed Modem Complying with two CCITT recommendations – V29 for 9600/7200/4800 bits per second and V27 bits/ter for 4800/2400 bits per second. 9620 has a variety of standard and optional facilities offering flexibility and user choice. 9620 s operational capability can be extended by the addition of an optional 4 channel multiplexer giving facility for multiplexing combinations of synchronous 7200 4800 2400 bits per channels. All channels are [illegible] with

The new high speed Type 9620 modem from SE Labs

BRAND NEWs

buffers and can be operated by simulated carrier control A max of 4 synchronous 2400 bits/sec input channels can be multiplexed for transmission at 9600 bits/sec Extensive use of advanced LSI and microprocessor architecture ensures efficiency reliability and cost effectiveness – Optimum performance even in poor line conditions is ensured by the incorporation of a powerful automatic and adaptive equaliser and phase jitter tracking circuit In addition to local diagnostic facilities (standard) 9620 can be fitted with remote diagnostic capability 210mm wide 127mm high and 420mm deep weighs 8 4kg

HARRIS

Semiconductor Ovies on *HMS 6564 CMOS static RAM* – introduced 1 yr ago as industry s first 64K device – now available in UK Consists of a 64K array of 16 4K static RAMs packaged into 1 8 sq ins of board space Array is organised as two 8K by 4 blocks of RAM sharing only address bus Data inputs data outputs chip enables and write enables are seperate for each block of RAM enabling user to organise memory as 8K by 8 of 16K by 4 array Decoupling capacitors are included to reduce noise and minimize external decoupling Cost in quantities of 100 up is £335 **OEMs**

HEWLETT-PACKARD

New *RS232C asynchronous serial interface* for HP 9876A thermal graphics printer (previously available with HP 18 IEEE 488 1978 interface bus or an 8-bit parallel (7 bit without parity interface) Switch selectable transfer rates from 50 to 19 200 baud full duplex protocol switch selectable (odd even none) parity 20mA passive current loop to implement remote operation Cables have standard 25 pin connectors HP 9876A thermal graphics printer with RS232C interface option sells for £2 544 **OEMs, BB (HP)**

KINSON ELECTRONICS LTD

RS232C 20mA serial interface for 4001 Programmable Event Recorder Allows bidirectional communication between 4001 and external peripheral devices such as paper tape punch vdu or printer Data transmission is at rate of between 50 and 2400 baud which is equivalent to 1 to 16 lines of standard 4001 printout per second Baud rate number of stop bits parity and half or full duplex operation can be selected to conform with nearly all commonly used standards 4001 itself in its simplest mode of operation accepts input on up to 16 channels arranged in 2 banks of 8 and will count events occuring on these channels Contains internal crystal controlled clock supplying both time of day and elapsed time Can be programmed by user to monitor industrial plant or scientific experiments and to automatically provide periodic printouts. Time interval between printouts user selectable At end of program run 4001 will produce a graph of the result if required 4001 accepts up to 100 events per second on each input each event being input as logic O with a minimum pulse length and separation of 5msecs Inputs can be contact closures or driven from TTL LS TTL L TTL or CMOS (4049/50) buffers For contact closure 4001 has a front panel control to select up to 8 different levels of bounce suppression **OEMs**

PLESSEY MICROSYSTEMS

Following the launch of its floating point unit has introduced a configuration for its Miproc high-speed 16 bit computer that operates as an associate processor to the DEC PDP 11 Miproc 16AP provides pre-processing post processing or fast I/O handling for any PDP 11 series computer and has a 250ns instruction execution time and a 10 megaword/sec DMA rate thereby significantly enhancing the PDP-11 processing ability in systems needing I/O overhead reduction or where existing system throughput is restricted by unwieldy or long algorithms I/O between the computers is achieved on a DMA DMA basis and a general purpose PDP 11 DMA to Miproc 16AP DMA software handler is included The program and the data to be processed can be down loaded to the Miproc 16AP from the PDP 11 The program for the Miprox 16AP s developed on a macro assembler and linker that runs under RT 11 or RSX 11 on the host PDP 11 An online debug monitor for the Miproc is also available Control of Miproc is accomplished from the PDP 11 system console I/O devices including A to D and D to A modules are available as is a 2-card set for 32 bit floating point capability The 16AP chassis houses up to 3 Miproc processors all of which can be connected to the PDP 11 thus allowing 3 separate tasks to be processed simultaneously £7720 with CPU 16K RAM Program Loader and Miproc to PDP-11 DMA (DR11 B) system The slots remaining in a chassis can be devoted to either all memory and I/O or floating point with memory and I/O In addition Plessey Microsystems has produced *SIGPAK* a signal processing package for the Miproc 16 Provides data acquisition pre processing and signal processing library functions including complex FFT function Package supports data acquisition on up to 64 channels (analogue) and can perform a variety of channel pre processing functions time domain statistical computations on channel data 512 point complex FFT power spectrum spectral averaging and bivariate analysis functions Available either as source code or firmware (PROM on a Miproc 16 Application Memory Card) £400 on single density floppy **Scientific**

RAPID RECALL

Various new products (1) *8289 Bus Arbiter Device* designed by Intel for use in multi master/multiprocessor systems Operates in conjunction with 8288 Bus Controller to interface 8086/8088/8089 processors to a multi master system bus main function is to establish a priority for a processor requiring access to a multi master bus and then controlling that access In addition 8289 when used with an 8088 or 8080 cpu can be operated in resident bus mode controlling communication over both a resident bus (with only one master) and a multi master bus This mode allows a processor in 8086 family to have peripheral and memory resources on a private or resident bus which it uses without contention with other processors on the system bus This frees up the system bus bandwidth and provides for increased system bus throughput (ii) *Range of 1K x 4 bit static RAMs* developed by Intel consume less power and have faster access times than earlier versions Designated 2114AL 2 2114AL-3 2114AL 4 2114A-4 2114A 5 the five new devices have been manufactured using Intel HMOS high performance MOS technology and are fully compatible with earlier 2114 static RAMs Max access times of 2114A family approx 50% lower compared with 2114 ranging from 120ns for 2114AL 2 to 250ns for 2114A 5 Current required approx 40% lower at 40mA for 2114AL 2/3/4 and 70mA for 2114A-4 and 2114A 5 Organised as 1024 words by 4 bits 2114A employs fully DC stable (static) circuitry throughout therefore requiring no clocks or refreshing to operate Address setup times are not required Data is read out non destructively and has the same polarity as input data Common I/O pins are provided Supplied in plastic or cerdip 18 pin package 2114A is fully TTL compatible (iii) *Battery Back Up CMOS RAM Memory Module* for use with LSI 11 Microcomputers Compatible with LSI 11 LSI 11/2 and LSI 11/23 systems the board is designated LSI 11 FO44 Occupies a single slot in LSI 11 back plane to provide 8K x 16 bits of non volatile read/write memory Board is divided into 2 memory blocks each of 4K words and the base address of each block can be set using small dip switches on the board Any 1K block of memory can be switch deselected if required On board power supply is provided by 3 DEAC button cells which are trickle charged from the 12V power supply during normal operation When fully charged battery will provide data retention for a minimum of 4 weeks Access time 350ns **OEMs**

RCS MICROSYSTEMS LTD

8 new Modules added to RCS 6800 Microprocessor Application System (i) *Twin Parallel I/O Module RCS 68 TPIO* contains 2 pairs of 8 bit parallel I/O ports giving a total of 32 I/O lines and 8 control lines Also contains a link programmable timing generator (ii) *Plain Paper Printer Interface RCS 68 PPI* provides control signals for one or optionally two 20 column alpha numeric plain paper alpha numeric printers (iii) *Digital Cassette Interface RCS 68 DCI* provides controls including record playback rewind write protection etc Up to 256K formatted data can be recorded per side (iv) *32K Byte Dynamic RAM Module RCS 68 DRAM* (v) *Metallised Paper Printer Interface* drives a 20 column alphanumeric metallised paper printer (vi) *Disc Drive Interface* with disc controller for up to 4 x 5¼ soft sectored floppy disc drives (vii) *VDU Controller* provides interface to CRT monitor giving 80 column alphanumeric vdu format (viii) *PROM Programmer* for 2708 and 2716 EPROMs Motorola 6800 based RCS 6800 already has processor 8K ROM 8K RAM parallel/serial I/O interfaces power supplies and interface modules **OEMs**

R.F COMPONENTS

New *Coaxial Line Switching Arrays* for handling data and r f transmission applications Simultaneously switches both inner conductor and outer sheathing Dual reed switches operated by a single coil connecting one output with one of several inputs or utilising stackability of basic blocks can give a cross bar switching effect from a 10 x 10 array of coaxial lines Coil operating voltages in range 4 to 80V d c Various coaxial connectors can be supplied for the inputs and outputs including B N C **Engineers.**

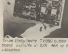
TEKTRONIX

CG551AP Programmable Generator latest member of TM 500 family of modular test and measurement products Microprocessor based can be used as part of computerised system for calibration and verification of major oscilloscope parameters (vertical gain vertical bandwidth/pulse characteristics horizontal timing and gain current probe accuracy and calibration output accuracy **Engineers, Labs**

The Tektronix CG551AP oscilloscope calibration generator

TEXAS INSTRUMENTS

TM990 210 series of microcomputer boards with bubble memory 23K 46K or 69K Byte capacities the series is bus compatible with such TMS990 based microcomputer modules as the TM990 series 210 employs TIB0203 bubble memory which has an asymmetric chevron geometry chip and uses major minor loop architecture to give a typical access time of 4ms data transfer rate 50K bits/sec Custom controller and all support circuits included Supply voltages +5 +12V and series fits TM990 510 and /520 card cages **Engineers, OEMs**



Texas Instruments TM990 bubble memory board available in 23K 46K or 69K byte capacities

ZILOG

(i) 6 *MegaHertz Z80B* faster version of Z80 Runs at 6.0 MHz clock rate compared to Z80A's 4.0 MHz and Z80's 2.5 MHz Pin/Software compatible with *Z80/Z80A* Available in PS (plastic package) CS (side brased ceramic package) and DS (cerdip package) versions (ii) Faster (6 MHz) version of Z8000 16-bit microprocessor Available as segmented *Z800 1A* in a 48 pin dual in line package or non segmented 40 pin *Z8002A* Former allows user to address up to 8 Mb of memory latter 64 Kb for memory intensive and non memory intensive applications respectively (Z8000 is a scaled NMOS silicon gate device that densely packs 17 500 transistors onto a single chip) (iii) *ZSCAN 8000* 16 bit Intelligent Emulator for use in developing system products based on Z8000 16-bit microprocessor Can be used stand alone or as front end peripheral interfaced to development system **OEMs**

Bureaux, Consultancies, Services, Shops

AUDIOGENIC

The mail order arm for PetPack software marketing *PETSET* *PETSET* consists of two buttons and a switch mounted in a printed circuit board which fits to front of PET by two tacky pads Allows user to get out of a crash condition without destroying any programs loaded into PET at the time and also clears all memory £15.75 for complete set **PU**

BRAND NEWs

COMPUTAHOME (LONDON) LTD

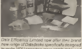
Offers computerised matching of potential buyers and properties in London Vendors pay registration fee of £30 and deal direct with matched buyers

CONTINENTAL SPECIALTIES CORP

Model WK 1 Wire Jumper Kit Contains pre cut pre stripped and pre formed lengths of solid insulated wire in 14 colour coded lengths from 0.1 to 4 inches Additional 0.25 inch ends bent at 90° and stripped 25 pieces of each length Supplied in compartmented plastic case with hinged lid £5 plus VAT **Engineers**

DATA EFFICIENCY LTD

DATADESKS designed to make vdu operation more comfortable and efficient Constructed from welded tube and sheet steel with laminated work surface 30 deep front to-back 28 high and 30 48 or 60 wide Options include Keyboard Well single double or triple drawers corner cheese pieces matching trolleys and custom made units to incorporate floppy disc drives printers media or document storage **SB MB, BB**



Data Efficiency Limited now offer their brand new range of Datadesks specifically designed to make VDU operation more comfortable and efficient Colour transparency of the new Datadesks are available on request from Publicity Department telephone (0442) 63561

DATA EFFICIENCY LTD

Market *TEXWIPE* contamination control and cleaning products for computers and the data processing environment Some 40 products in range including Multi Product Evaluation Kit £19 plus VAT **SB MB BB**

MOORE PARAGON

SPEEDIWEB forms construction designed to solve the problem of detaching computer produced continuous forms immediately after printing at the point of sale or distribution For use on terminal and small business computer printers with form feed tractors above print line Unnecessary to feed next form set in order to detach hence no paper wastage Up to 6 part set standard available in 2 styles – Audit, leaving audit copy in printer in continuous form and Burst in which all forms may be removed Variety of form depths with one time carbon or carbonless Moore Clean Print (MCP) **SB MB, BB**

NEWBEAR COMPUTING STORE LTD

Editor Assembler already proven on Nascom 1 TRS 80 and standard general purpose version (Intel format) now implemented on Sharp MZ 80K Includes Monitor/Debugger all commands on one no reloading single byte breakpoint all Z80 user registers visible Display Modify memory in decimal hex octal or ASCII runs in 4.5K Object to cassette or RAM £19.50 plus VAT from Newbear stores or Sharp MZ 80K distributors **PU**

PERSONAL COMPUTERS LTD

Multi Function Numeric Keypad for use with Apple II computer 10 numeric keys (inc double width zero key) 8 function keys (right/left cursor minus escape slash space return (double width) and period) Plugs into any available expansion slot sub routines for control of the keypad are contained in the ROM on the module itself Gold contacts provided £125.00 **PU**

POWER EQUIPMENT CO LTD

Mini Printer Silencers designed for use with Commodore PET Anadex DP8000 Centronics 730 OKI Microline 80 ITOH 8300 printers and other compact receive only machines Desk or pedestal adjustable inlet/outlet slots in rear panel accomodates base feed paper systems Metal body dense foam lining Installation requires no tools Optional cooling fan **PU SB**

POWER EQUIPMENT COMPANY LTD

HUSH TOPS range of optional extras for use with its business machine noise control enclosures Enable accoustic Silencer cabinet designed to quieten tractor-feed printers to be used with printers fitted with bulky sheet feed attachments Fitting does not require tools Hush Tops now available with Powquip Silencers designed to quieten 8 models of printer including Alphatext 2000 Diablo (RO and KSR versions) and Qume Sprint in standard and wide carriage form A Hush Top and Silencer surrounding a Diablo RO printer will reduce noise output down to 58 dBA a significant reduction of between 70 80% say the makers **MB**

WILKES ONLINE STORES

New store at 10 Melford Court Hardwick Grange Warrington Offering immediate delivery on a popular range of computer media and accessories as well as stocks of single and multi-part listing paper

ZX80 USERS CLUB

Formed in London to create and share software written in Sinclair ZX80 £100 personal computer's 1K RAM Membership free to ZX80 owners and includes newsletter **PU**

Exhibitions, Courses, Events

AUTOMATIC TESTING '80

Centre International de Paris [illegible] Conference programme includes *Testing Microprocessors Self Testing [illegible] of PCBs Analogue and Hybrid LSI [illegible] Testing Automatic Testing of Telecommunication Systems Production Testing [illegible] Use of ATE [illegible] Testing and Future Trends* Organised [illegible] NETWORK

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Series of [illegible] day Courses on programming in Pascal Supported by DoI under Microprocessor Applications Project (MAP) Concentrates on structured programming practice Each participant has own terminal linked to

[illegible]

CAMBRIDGE MICROCOMPUTERS LTD

The [illegible] of the [illegible] microprocessor [illegible] Spo [illegible] the [illegible] for [illegible] and [illegible] Also [illegible] the [illegible] package [illegible] lattice [illegible]

CONTROL DATA

Control Data Institute [illegible] training and computer [illegible] designed to meet the varying [illegible] industrial and [illegible] courses [illegible] through [illegible] systems analysis [illegible] Available [illegible] including [illegible] RPG II IBM [illegible] all [illegible] Data [illegible]

ELECTRONIC DISPLAYS 80

Mount Royal Hotel London Sep [illegible] Organised by NETWORK include [illegible] and conference under chairmanship of Prof R L Grimsdale [illegible] programme [illegible] Technology [illegible] manufacturers [illegible] and [illegible] displays [illegible] including the [illegible]

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KALAMAZOO BUSINESS SYSTEMS

Training Course for computer staff under Manpower Service Commission's Training Opportunities Scheme 10 week course starting on Nov 10 in a £10,000 purpose built extension to Kalamazoo Clerical Training School at Northfield 20 places open to any one over 19 who has been out of full time education for two years

MSS COMPUTER AND BUSINESS CONSULTANCY LTD

Courses to be held [illegible] August September *Effective Budgeting and Financial Planning* August [illegible] *Introduction to Management* [illegible] August [illegible] *Introduction to Programming* August [illegible]

BRAND NEWs

[illegible] Management [illegible] Computer [illegible] Aug [illegible] Sept [illegible]

UNIVERSITY OF SURREY

New Degree Course *Physics with Microcomputing* Aims to produce physicists with expertise in the instrumental and computing techniques related to the applications of microprocessors particularly in physics [illegible] concerned with the design and production of microprocessors 4 year sandwich course [illegible] 2 years University [illegible] industry [illegible] Physics [illegible] developed [illegible] and [illegible] signals and other relevant aspects of microprocessors Details from Dr J C [illegible] Dept of Physics

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TLC COMPUTER SERVICES

Computers Simplified One day Courses [illegible] designed for the smaller firm No previous knowledge assumed [illegible] £30 + £4.50 VAT [illegible] and Fridays 10 am [illegible] pm Refreshments lunch and documentation included

Literature

ACT PETSOFT

The PET Collection Spring 1980 Catalogue of PET software from Petsoft, ACT Personal Software Osborne and Associates Programma International and other suppliers **PU, SB (PET)**

APPLE

APPLE *The Personal Computer Magazine and Catalogue* Volume 1 Number 3 $2.00 Available direct or from Microsense **PU SB (Apple)**

'COMPUTERS IN SCHOOLS'

Journal of *MUSE* (Microcomputers in Secondary Education) Vol 2 No 8 Covers Computing for Infants Computer Aided [illegible] Building the ZX80 Crash proofing the 380Z [illegible] Longmans

CONTROL DATA

New 50 page *Directory of Application Services* Over 100 specialist packages listed including CYBER scientific and engineering services CALL management time sharing and commercial data processing **MB BB (DG)**

EMI SELABS LTD

New Applications Bulletin Problem Solving Latest issue concentrates on data recording aspects of monitoring testing and evaluation work carried out by a number of organisations Free

INTEL

Technical House Magazine *Intel Preview* recently published outlines company's technological advances particularly 2920 analogue processor 8089 I/O processor CIS COBOL 2147H 4K MOS static RAM Model 241 hard disc based microcomputer development system and the integration of iSBC boards with Eurocard modules Also details of workshop courses **Engineers OEMs (Intel)**

NEWBEAR COMPUTING STORE LTD

Fully Commented *Assembly Listing of Sharp MZ 80K 14K BASIC* (SP5025 BASIC) and manual describes the structure of the BASIC and the facilities embedded in it Newbear BASIC description £30 Newbear 4K Monitor description £15 Sharp BASIC Manual £7 Sharp Hardware Service Manual £7 All from branches of Newbear or Sharp MZ-80K distributors **PU (Sharp)**

Sharp MZ 80K Personal Computer

PETSOFT

Understanding Your PET/CBM 240-page quarto sized guide to programming the PET Covers all models in the 2001 and 3000 series PET and CBM ranges Readily comprehensible by newcomers to computing Includes a compilation of five volumes of the best-selling PET Workbooks Available direct at £15 plus 75p post and packing or from PET dealers **PU SB (PET)**

QUEUE

Catalogue of Educational Software for Apple PET and TRS 80 computers All software can be ordered directly from QUEUE **PU, Teachers (PET)**

RAPID RECALL

New 40 page *Price List* valid from April 1980 Divided into two main sections products from Digital Equipment Corp (DEC) and from Intel Corp Includes a short description of each product and in most cases several price breaks are given

TORBUS

Sole agents for *NIBBLE* – Apple Magazine Tips and techniques projects product news and reviews etc £17.50 per year (8 issues) inc postage **PU SB (Apple)**

Addresses on page 84

▶ From page 46

```
    begin
    if transrec accno = accountrec accno then
        begin
        (*  found the corresponding account record  *)
        accountrec balance = accountrec balance + transrec amount
        read a record from the transaction file putting it in
        transrec
        end
    else if transrec accno > accountrec accno then
        begin
        (*  still haven't found the corresponding account record *
        (*  copy the account record into the new account file    *
        (*  and read the next account record                     *
        write accountrec into new account file
        read a record from account file putting it into accountrec
        end
    else if transrec accno < accountrec accno then
        begin
        (*  error in transaction   This has occurred  *)
        (*  just after position (A)                   *)
        print transrec on an error listing
read a record from the transaction file putting it in transrec
    end
end
(*  there may be some account records to be read after the   *)
(*  transaction file has been fully read   Copy the rest of  *)
(*  the account file across to the new account file          *)
While the end of the account file hasn't occurred  do
    begin
    write accountrec into the new account file
    read a record from account file putting it in accountrec
    end
(*  there may be transaction records left in the transaction *)
(*  file after the account file has been fully read   These  *)
(*  are errors, this corresponds to what happens after       *)
(*  position (B)
While the end of the transaction file hasn't occurred  do
    begin
    print transrec on an error listing
    read a record from the transaction file putting it in
    transrec
    end
```

Fig A2 *(continued from p46)*

formal notation the comments I shall enclose with (* and *)

I have assumed the existence of variables which are able to hold transaction records and account records

I shall refer to the contents of the field by writing the variable followed by a full stop and the field name Thus if I have a variable called *transrec* which holds transaction records then the account number will be written as a *transrec accno* If I have a variable called *accountrec* which holds account records then the balance will be written as *accountrec balance*

The algorithm can be expressed as
(see page 46 Fig A1)

This is a very simple solution to the update problem It would never be programmed in this way in a commercial environment The main objection to the algorithm that I have presented is that it makes no provision for the *handling of errors*

Errors occur when the transaction file is created from source documents It is clearly foolish to expect a data preparation clerk to type every transaction record correctly especially when a large number of transactions are involved It is up to the designer of a file maintenance program to build in provision for the deletion and handling of errors

A large number of errors in a transaction file can be detected by means of a program called a **data edit** or **data vet** program which processes the transaction file, rejecting any transactions that are incorrect, these can be corrected and added to a later transaction file

However errors do get carried into the updating program In the main these are concerned with the key field and the usual consequence is that a transaction record occurs in the transaction file that is not matched by a record in the account file Consider what happens with the files shown in Fig 9 (page 45)

The transaction file contains three records with keys that *do not exist* on the account file (3080 9021 9023) If we assume that the last record that has been read on the transaction file and the account file both have a key of 2016 (position (A)) then the next record read in the account file will have a key of 3811 This is an error since 3080 will not occur in the account file This error can be detected by testing the condition

transrec accno < *accountrec accno*

At position (B) on the diagram the record with key 9000 has just been read and the corresponding account record has been read The next read on the account file will signal the end of that file This means that two erroneous transaction records (9021 9023) have not yet been read They can be listed as being in error by reading to the end of the transaction file and printing these records out as errors My algorithm now becomes (See page 46 for start; Fig A2)

The above algorithm should then produce a new account file *and* a listing of all t[illegible] records in error

Although I have dealt in some length with the problem of modifying a file of records contained in a sequential file I haven t addressed the problem of inserting or deleting records in the file

This can be handled in a straightforward manner by modifying the format of a transaction record and this would now contain more fields (Fig 10)

code	accno	amount	name

Fig 10

Code would indicate the *type* of transaction, blank for modifying a field D for a delete operation and I for an insertion **Accno** would hold the account number of the *record* to be modified deleted or inserted **Amount** would hold the *sum* to be debited or credited this field would only be full if code was blank **Name** would consist of the name of the holder of a *new* account this field would only be full if the code contained an I

Some typical transactions are

1)

	7734	12.33	

add £12 33 to account number 7734

2)

D	7129		

delete account number 7129

Series

3)

I	1734		S J Vowles

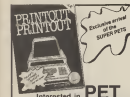
Insert a new account with an account number 1734 for a customer, S J Vowles

Modifying the previous algorithm to handle deletion and insertion is straightforward I shall describe how deletion is achieved and leave modification or insertion up to you it will be a good test to see whether you have understood this article fully The modification consists in not copying the corresponding account record into the new account file (see below Fig A3)

```
If transrec accno = accountrec accno then
   begin
   (*  found the corresponding account record  *)
   If transrec code = 'D' then
      (*  record in account file is deleted  *)
      Read a record from the account file putting it in
      accountrec
   else
      begin
      (*  modify the amount field  *)
      accountrec balance = accountrec balance + transrec
      amount
      read a record from the transaction file putting it in
      transrec
      end
```

Fig A3

● *To be continued*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DEMONSTRATION THREE

A Model of Diffusion

R[illegible] that the [illegible] FORTH [illegible]

This month we develop a programme which makes use of random processes to serve as a model of diffusion or just as a game of chance if you prefer it. It also illustrates a particular technique in FORTH.

Programming in FORTH is essentially well structured. There is, for example, no GOTO statement. Many programmers brought up on BASIC miss it. Of course all languages support some form of disciplined GOTO. A conditional loop is such a form. The point is that you lay down pointers which announce at the outset where you will jump to if a certain condition is or is not met. This improves the readability of the programme.

The BEGIN ... END statement is such a structure. If there is a zero on the stack on arrival at 'END' then the programme goes back to 'BEGIN' (which is the pre-arranged marker). Otherwise it skips over END to the next word.

So GOTO is reinstated in a disciplined fashion. You can use a 1 to escape from the loop or a ZERO to stay in. The following programme illustrates the technique for nested BEGIN ... END loops. The programme simulates a particle, say a gas molecule, which travels along until it reaches a barrier which it has a definite probability of traversing. If it doesn't pass through it bounces back. There is a succession of such barriers to get through.

The question is: What is the probability that it gets through the lot? A counter is incremented each time it succeeds in doing so and this result is divided by the number of attempts made. If the process is displayed on a graphics screen you can gamble on its chances.

This programme contains four barriers and five nested loops. Words such as 1ON and 2ON are defined to mean what the particle does when it passes the first barrier. RETNE (ENTER backwards) is a bounce off the first barrier. 1BACK is a bounce off the second; the ATEST and BTEST are the transmission probabilities on the way forward and on the way back. EXIT is the passing of the last barrier. So after EXIT you need tickets to get out of four loops. These are provided by the 1 1 1 1 which appear after EXIT in the programme on screen 3. The zero which traps you in the final loop is put on the stack at the beginning. The outermost IF mates up with the outermost ELSE, ie IF 1ON ... ELSE RETNE represents the decision on arrival at the first barrier having just conducted an ATEST to see whether it is to go on or go back. The programme is developed in three screens (this is the name given to programme memory blocks in the version I am using). Screens 1 and 2 define words to put a moving point in five sections of the VDU. Screen 3 contains the actual programme.

I am not pretending that this is good programming. You don't need more than two nested loops for any number of barriers with a variable to state which barrier you are at. Try it!

```
  SCREEN 1 BARRIERS
( ****************

: WAIT 0 DO LOOP ;
: ENTER 76 0 DO WHITESPOT I 80 10 WAIT
PLOT ERASE I 1 - 80 10 WAIT PLOT LOOP ;
: RETNE 34 0 DO WHITESPOT 33 I - 80 10
WAIT PLOT ERASE 34 I - 80 10 WAIT PLOT
LOOP ;
: 1ON 60 1 DO WHITESPOT I 36 + 80 PLOT
10 WAIT ERASE I 35 + 80 10 WAIT PLOT
LOOP ;
: 2ON 60 1 DO WHITESPOT I 96 + 80 10
WAIT PLOT ERASE I 95 + 80 10 WAIT PLOT
LOOP ;
: 3ON 60 1 DO WHITESPOT I 156 + 80 10
WAIT PLOT ERASE I 155 + 80 10 WAIT PLOT
LOOP ;
;S

  SCREEN 2 BARRIERS
( ****************

: EXIT 41 1 DO WHITESPOT I 216 + 80 10
WAIT PLOT ERASE I 215 + 80 10 WAIT PLOT
LOOP ;
: 1BACK 60 1 DO WHITESPOT 94 I - 80 10
WAIT PLOT ERASE 95 I - 80 10 WAIT PLOT
LOOP ;
: 2BACK 60 1 DO WHITESPOT 154 I - 80 10
WAIT PLOT ERASE 155 I - 80 10 WAIT PLOT
LOOP ;
: 3BACK 60 1 DO WHITESPOT 214 I - 80 10
WAIT PLOT ERASE 215 I - 80 10 WAIT PLOT
LOOP ;
;

  SCREEN 3 BARRIERS )
0 VARIABLE TRIALS 0 VARIABLE WINS
0 VARIABLE P
: PROBABILITY 3 255 P @ - 256 AR ;
: ATEST RANDOM RPR P @ > ;
: BTEST RANDOM RPF P @ < ;
: BARRIERS 0 BEGIN ENTER ATEST
BEGIN IF 1ON ATEST BEGIN IF 2ON ATEST
BEGIN IF 3ON ATEST BEGIN IF EXIT
                    1 WINS +! 1 1 1 1
ELSE 3BACK BTEST 0 1   THEN END
ELSE 2BACK BTEST 0 1   THEN END
ELSE 1BACK BTEST 0 1   THEN END
ELSE RETNE         1   THEN END
1+ DUP TRIALS @ >          END DROP
TEXT HOME
6 DOWN CR ." WINS=" WINS @ . CR CR
  ." TRIALS=" TRIALS @ . CR CR
  ." PROBABILITY PER BARRIER="
PROBABILITY CR CR
  ." TOTAL PROBABILITY=" 3 WINS @ TRIALS @
AR/ ; ;S
```

Here, to finish, is a programming problem which I call 'Instant Ben Nicholson' (if you don't get the context refer to Brian Reffin Smith). The objective is to place on the Apple screen random sized squares in random positions. The screen has a fixed window size and we need to avoid overlapping the edges. FORTH programming uses top down design so we start by assuming we have a word which will do the trick. Call it TEST or any other word you care to choose. We will also need a word called SQUARE and a pair of random numbers to fix the centre. We then want a random variable to decide the length of the side. By means of this we can locate the four corners and join them up with a line. LINE has already been defined. We must first, however, check that it will not overlap the edge of the screen and move it in till it doesn't.

We already have a word RANDOM so we can define a word RGET to generate a random number and put it on the stack. Finally, the random number we have been using lies between 0 and 255 (one byte).

The square could be too big for the screen. You can get over this by forming a logical 'and' with 63; this is a bit comparison and reduces the range to 0 to 63.

Lastly I suggest you make the TEST word an open-ended loop so that, for example, 10 TEST will put 10 squares on the screen.

The whole thing looks more interesting if a delay is included in the loop. Then, having decided just what you want, you write the programme from the bottom up so that each word in the programme makes use only of words already defined. ■

• *Gil Filbey lectures in Physics at the Polytechnic of the South Bank, London*

Book Review

Patrick Sutton

Microcomputer Analog Converter Software and Hardware Interfacing by J A Titus, C A Titus P R Rory and D G Larson (Howard W Sams and Co Inc 283 pages, £6 20)

This book introduces the reader to the concepts and techniques of interfacing microcomputers to analogue electronic devices A tutorial style is adopted and the text is divided into seven teaching units covering topics such as D/A and A/D converters conversion techniques sample and hold circuits etc Unit 7 consists of a series of experiments to be performed by the reader and concentrates, as does the rest of the book, on commercially available converters and their interfacing to 8080/8085 based microcomputers The compatability of the Z80 with the 8080 microprocessor means that users of Z80 based systems such as the Nascom may also find this book useful The general layout of the book is clear with numerous circuit diagrams and programme listings given and its scope is such that it should be of interest not only to microcomputer hobbyists but also to professional users

The appendices at the end of the book are particularly useful as they are reprints of converter manufacturers data sheets whose detail supplements the information given in the rest of the book

EDITOR'S CHOICE

The Dictionary of Diseased English by Kenneth Hudson Papermac (£2 95) If you intend writing for *Computer Age* or any other publication with standards have this book close by you

Games of Logic by Pierre Berloquin Unwin Paperbacks (£1 95) Foreword by Martin Gardner Middlebrows will have plenty of fun with this book

Distributed Micro/Minicomputer Systems by Cay Weitzman Prentice Hall Inc (Hardback £14 95) The author believes that this decade will see the widespread use of distributed data processing Though frankly a specialised text for university use the book will be of great use to systems specialists It is highly readable and thorough

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SOLVING PROBLEMS IN PROLOG

The first article introducing PROLOG appeared in last month's issue. This month the author examines how knowledge of the theorems of elementary plane Euclidean geometry can be formulated as a computer program capable of solving geometrical problems and uses a representation in the language PROLOG to illustrate this.

●Bob Welham is formerly of the Department of Artificial Intelligence, Edinburgh University, Scotland.

Introduction

Workers in Artificial Intelligence have always been interested in the automation of mathematical reasoning. This may be partly because, like the author, many researchers in the field are themselves ex-mathematicians, but it is also because, like chess, mathematics provides a domain of intelligent human behaviour which is sufficiently precise to be relatively easily formulated in computational terms. We are not discussing here the fields of numerical analysis, operation research or number crunching in general, but rather those branches of mathematics where the reasonings and computations are of a non-numerical nature.

Euclidean plane geometry is such a domain, and most of us will remember from our schooldays how we wrestled with concepts such as congruent triangles, isosceles triangles, parallel lines and so on. In this article we will look at some of the ways in which we might write a computer program to solve problems in geometry, that is, at how we can represent our knowledge of geometry in a way which will be meaningful to a computer.

Several geometry problem solving programs have been written during the history of Artificial Intelligence, and they have solved many and varied problems. We shall look at one problem in particular which was solved in a quite novel and unexpected way.

This sort of pure research should eventually bear fruit in such areas as education, where a better understanding of exactly how we can solve problems in mathematics will be of great use to the designers of computer programs intended to teach children these skills. Engineers and scientists would also no doubt be very happy if computers could take over the non-numerical aspects of their mathematical problems as they have so successfully done with the numerical calculations which once seemed so intractable.

The Representetion of Geometric Knowledge

In a previous article in this series we looked at the programming language PROLOG (PROgramming in LOGic) and I hope now to give some idea of the power and flexibility of PROLOG by showing how we can represent the standard theorems of geometry as concise procedures in PROLOG.

```
Consider the PROLOG procedure -
congruent-triangles (XYZ, PQR)

      ← equal-sides (XY, PQ),

        equal-sides (YZ, QR),

        equal-sides (ZX, RP)
```

This is the PROLOG representation of the well known theorem of geometry which states that triangle XYZ is congruent to triangle PQR if each side of one is equal in length to the corresponding side of the other, that is if XY = PQ, YZ = QR and ZX = RP. Two triangles are said to be congruent if one is an exact copy of the other. This is illustrated in figure 1.

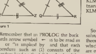

Figure 1

Remember that in PROLOG the backwards arrow symbol ← is to be read as "if" or "is implied by" and that each procedure such as (1) consists of the *procedure head* on the left hand side of the arrow and on the right hand side of the arrow the *procedure body* which itself consists of a number of *procedure calls*, separated by commas. So we can think of (1) as stating that whenever we are required to solve a problem *congruent-triangles* (XYZ, PQR) then we can replace this problem with three sub-problems *equal-sides* (XY, PQ), *equal-sides* (YZ, QR), *equal-sides* (ZX, RP).

This device of representing knowledge as procedures, that is, as *executable code*, is a very powerful one and is widely used in Artificial Intelligence. It is known as the *procedural representation of knowledge*, or as *representing knowledge as programs*. The language PROLOG is highly amenable to representing knowledge in this way, and to workers in Artifical Intelligence this is one of its main attractions.

To give a further example consider the procedure

```
equal-angles (UVW, KLM)

      ← congruent-triangles (UVW, KLM)
```

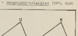

Figure 2

In geometric terms this states that angle UVW is equal to angle KLM if triangle UVW is congruent to triangle KLM. In computational terms we can interpret the procedure as stating that if you want to prove that angle UVW is equal to angle KLM, then you can do it by proving that triangle UVW is congruent to triangle KLM.

An Unexpected Result

Some years ago a geometry problem solving program was asked to prove the theorem about an isosceles triangle which states that if two sides of a triangle are equal then the angles opposite those two sides are also equal. Again let us formulate this problem in PROLOG and then see what happens.

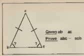

Figure 3

Remember that our convention when writing in PROLOG is that capital letters are used for program *variables* as in procedures (1) and (2) and that lower case letters are used to name actual data objects or *constants* So we may postulate our problem as that given that sides ab and ac are equal, we must prove that angles abc and acb are also equal (see figure 3) In PROLOG our input data or hypothesis that ab = ac may be represented as

```
equal-sides (ab, ac) ←
```

Note that this is what most programmers would call *data* as opposed to *code* but that in PROLOG both data and code have the same fundamental representation, namely that of a procedure with a procedure head and a procedure body consisting of procedure calls The interesting thing about (3) is that here there is no procedure body, and all that this means is that if we ever want to solve the problem *equal sides* (ab ac) then we don't have to go any further this particular problem is solved unconditionally and there is no need to break it down into sub-problems

Now procedures that have no procedure body need not necessarily be devoid of variables as in (3) For example the procedures

```
equal-sides (XY, XY) ←

and  equal sides (XY, YX) ←
```

are unconditionally true by identity for all values of X and Y Let us now imagine that we have a PROLOG geometry problem solving program which consists of procedures (1), (2) and (5) above and that in addition we have input the data procedure (3) Now let us input the *goal statement*

```
← equal-angles (abc acb)
```

A goal statement in PROLOG is a procedure with no procedure head just a procedure body consisting of a number (in this case one) of procedure calls which we are asking the system to execute So if we input (6) we are asking the program to execute the procedure call *equal angles* (abc acb), that is to prove that angle abc is equal to angle acb

PROLOG now proceeds by *matching* a procedure call from the goal statement with some procedure head and the only one that matches in this case is the head of procedure (2) To make this match, the variables U, V W, K L and M appearing within (2) takes on the values a, b c a, c and b respectively Then replacing the procedure call within the goal statement with the body of the procedure whose head it matched and filling in the values of the variables within that procedure body, PROLOG changes the goal *equal angles* (abc acb) to the goal

```
← congruent triangles (abc, acb)
```

What the program is now doing, is looking at the triangle in two different ways and trying to prove that these two triangles are congruent

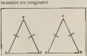

Figure 4

PROLOG now begins its cycle again and looks for a procedure whose head matches the procedure call in (7) namely *congruent-triangles* (abc acb)

Again there is only one such procedure namely (1) and the match is obtained by the variables X Y Z, P Q and R within (1) taking on the values a, b c a, c and b respectively Making these substitutions with the procedure body of (1) and replacing our procedure call with this procedure body we get the new set of goals -

```
← equal-sides (ab, ac)

  equal-sides (bc  cb),

  equal sides (ca  ba).
```

Here the current set of goals consists of more than one procedure call as is usually the case For our present problem the first member of the set above namely *equal sides* (ab ac) matches the head of procedure (3) our input data and because (3) has no procedure body it is solved forthwith Similarly the second member *equal sides* (bc cb), is solved immediately by procedure (5) with the matching substitutions X = b and Y = c This leaves us only to execute the procedure call equal sides (ca ba) which is really again *equal sides* (ab ac) which is given as data You will see that here we have assumed that the goals ca = ba and ab = ac are the same, which indeed they are geometrically

To realise this within our program we would need the extra procedures

```
   equal-sides (XY PQ) ← equal sides (PQ XY)

and equal-sides (XY PQ)   equal sides (YX PQ)
```

So our simple program has produced a very elegant proof of the isosceles triangle theorem The actual program which produced this proof was not written in PROLOG but encoded essentially the same procedures Referring back to figure 3, the proof is thus:-

Consider triangles abc and acb
ab = ac (given)
bc = cb (identical)
ca = ba (given)
Therefore triangles abc and acb are congruent (side side side)
Therefore angle abc = angle acb Q E D

The human geometer almost invariably will draw a diagram of the problem that he wishes to solve and will only spend effort trying to prove things which look right in the diagram He will not waste effort trying to prove equal two lengths which are in the diagram wildly different We can give our program a diagram in the form of a pair of X - Y co-ordinates for each geometric point in the problem making sure that all the hypotheses of the problem are true in this diagram Thus for our isosceles triangle problem we might furnish the program with a diagram in which a is the point (1 2) b is the point (0 0) and c is the point (2 0)

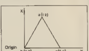

Figure 5

This diagram then satisfies the hypothesis that ab = ac (both are of length 3) but notice that ab ≠ bc (the length of bc is 2)

In a general geometry problem solving program, the actual numerical values of lengths and angles given in the diagram for any particular problem can be used to reject procedure calls which occur while solving that problem, without actually trying to execute those calls The idea is that if a particular goal within is not true in the diagram then there is no point in trying to prove the goal within the program More generally there is no point in trying to prove something if there is at hand an example which contradicts it

For instance if while working on some problem involving the diagram in figure (5) the program comes up with the goal *equal sides* (ab, bc) then this goal will be immediately failed because in the diagram ab ≠ bc In a complex problem with a complex diagram this *diagram filter* technique will save a lot of computational effort by preventing the program from wasting time trying to prove unprovable goals, that is trying to solve unsolvable problems The diagram *must* confirm strictly with the hypotheses or input data of its corresponding problem otherwise the program will also reject *provable* goals On the other hand to be maximally effective the diagram should not have any spurious or coincidental equalities of lengths or angles only the necessary ones If we had unwisely chosen the point (3 0) for c in figure (5) then ab and bc would not be coincidentally equal in the diagram and the unprovable goal ab = bc would no longer be rejected by the diagram filter Then much effort might be wasted trying to prove it We must choose our diagram to be as irregular as possible while still conforming to the hypotheses of the problem

In another article we shall look at another branch of mathematical reasoning in which progress has been made, that of solving symbolic algebraic equations ■

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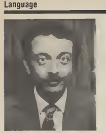

A PEERLESS LANGUAGE

There is a busy and forceful movement to create computer languages that are "natural". But many computer scientists say that this is the last thing we need: ambiguity and imprecision.

There is a possibility that one day APL will be available on all microprocessors. And not just to write and test assemblers. Certainly it is the programming language most likely to find universal acceptance, as it can be equally useful to a beginner or an expert, to a scientist or a businessman. But for that day to come, two events have to occur. The manufacturer has to appreciate the profits realisable from the implementation of a universally acceptable language, and every class of user has to feel confident with APL. Possibly the former will be achieved first, as the latter may only be fully achieved when APL is part of the curriculum of all schools, colleges, universities, etc. This may actually take some time, as mathematicians and scientists who could make such productive use of APL are mostly still heavily ensconced in languages like FORTRAN.

'APL is far more than a programming language'

Nursery crimes

Part of the appeal of children's rhymes is their constancy. One example I heard for the first time recently seemed to be the better part of one hundred years old, judging from internal local references. Looking so far back into the dawn of history was obviously quite a strain on the comprehension of the little one who told me the rhyme; her next contribution was nothing like so old, however. It went:

I'm a little robot, short and square
Got no toes, got no hair
When you want the answer to your sums
Press a button, out it comes

It is no doubt interesting to see new technology penetrating the collective consciousness, but it surely deserves better treatment? The rate of one major misconception per line must be something of a record.

While one might object to

- the confusion of computers with robots
- the anthropoidal image of computers and robots

and

- the assumption that computers are primarily numeric in application

it is that last line that really rankles me.

Doesn't the programmer deserve a mention?

● *Phil Chastney, writing in the I P Sharp newsletter. The newsletter is devoted to APL, as are I P Sharp Associates.*

It is hoped, therefore, that this article, by presenting a fresh viewpoint of APL, could assist in furthering a greater acceptance of the language as a multi-purpose high level language without peer.

For those who have still not sampled the joys of APL, it has one aspect worth making clear at the outset. 'Raw' APL contains a set of symbols based on a special character set – letters and numerals are also included, but there are no reserved words. The user can, however, name the data (variables) or sets of instructions (functions) in any way he wants, so that his final suite of programs can resemble any other programming language (or any mother tongue) he is familiar with, while still retaining all the power of APL. APL can therefore be used very flexibly by a wide variety of users over the whole spectrum of applications, from the trivial 'desk calculator' mode to any mode of scientific or commercial complexity required.

The user then finds that not only is APL very flexible compared to other high level languages, it is usually vastly more productive. The reason APL increases productivity over other high level languages is the concise, simple nature of the language. As one progresses from machine logic through machine language, Assembler, through high level languages to APL, the number of instructions required to perform a given task decreases. But actually the number of instructions executed by the machine remains the same, though the number of instructions required of the programmer is dramatically reduced. As the number of statements decreases, so of course does the risk of error, whereas the degree of simplicity and freedom increases inversely.

APL can thus be far more productive than other high level languages such as FORTRAN, BASIC, PL/1 and Pascal. This is so whether we are referring to a beginner or an expert, a scientist or a businessman. The crux of the matter, however, is that it is not actually sensible to compare APL with other languages. The comparison is not like with like.

To achieve a proper appreciation of APL, it is worth considering the very structure of language itself. Microprocessors have relieved many of the hardware and software constraints associated with computers, and brought prices down to a level where computers can directly reach many more people. The language barrier still exists, however. The major difficulty is the fact that language is an extension of thought. To adapt to a language is more difficult than adapting to a machine, as many would-be program writers have discovered. A language is constituted by the fact that it has a distinctive vocabulary – a set of 'primitive ideas' or 'basic concepts' – and a 'syntax': a set of rules for 'translating' the sentences of the language into other sentences.

But this is not all. In data processing, we are concerned with logical processing of data. While the data may represent real world events and objects, they must be in symbolic form to be processed. *The fundamental base of data processing is symbology.* We must ask ourselves what are the most effective ways of symbolising both real and abstract events, storing the symbolic forms, and then manipulating the stored symbols in useful ways? APL is not the whole answer, it may be only part of the way there, but in comparison with other programming languages, it comes off very well.

This is because APL is far more than a programming language. Unlike most other high level languages, APL was conceived independently of any given machine. In its original form, it was used to improve communication between man and man, rather than man and machine. Some time later, when it was first implemented on a computer, this machine-independence was retained, though implementation will vary slightly from version to version.

Similarities in ease of learning of APL and verbal (spoken) language are immediately apparent. APL syntax is uniform and extremely simple. It can therefore be learnt in 'building block' mode, just as a child learns to talk or indeed to carry out other tasks. A small subset of syntax rules, system commands and language 'functions' can be learned within one or two hours. A larger subset of the language is learned progressively as the user masters each step. The new APL user soon discovers that with relatively little effort he can perform complex tasks. This stimulates him to learn more of the language. In this way the APL user continuously builds on his knowledge as he uses it. APL is not taught, it is learned. People learn APL by using it.

'APL extends thought processes'

APL adapts itself to the logic of the problem, *not* the logic of the computer. The user often finds that the statement of his problem in APL is the direct cue to the computer to solve it. APL is therefore a *user* language – not a *computer* language. The user 'teaches' the computer; he is the master of the computer, not the slave. Above all, APL represents what the user wants to do, not the computer.

Verbal language (eg. English) is not precise enough for good data manipulation. The concept that programming language should be like human language is a widely held fallacy that has misdirected programming development for many years. The universal acceptance of the system for musical notation demonstrates that verbal language has inherent limitations. Verbal language has its forte in the discussion of philosophy (as now), not in the manipulation of data. If English is too imprecise, what better candidate for a programming language than a general purpose, consistent system of mathematical notation that could be taught at elementary school, as is music. Children would grow up with the ability to program as naturally as they sing – *they* would prove how easy it is to learn and to use APL.

Philosophy of APL

APL is a language *and* a system, a way of life, a philosophy. In short, it provides the bridge between creative lateral thinking (cf. Edward de Bono) and effective vertical thinking (cf. Thomas Alva Edison). APL has stripped away the mask from the computer, and helped to remove the language barrier that will remain however much prices tumble.

If computer specialists are searching for a language that serves most closely as an extension of human thought processes, then APL is undoubtedly a strong candidate. APL extends thought processes – it does not constrict them. Ask anyone who has used it. Better still, anyone who has any doubts about APL should not ask anyone else for an opinion. He should try APL for himself, and see the proof with his own eyes.

If this article has brought one more person closer to the joys of APL then it has served sufficient purpose. But no-one associated with programming should leave APL out of the repertoire of languages he has tried. ■

Dr. Caplin gained his Ph.D. in Organic Chemistry at Sheffield University, where he first used computers for simulations. His post doctoral work was at the Hadassah Medical School, Jerusalem, where he used computers for regression analysis. He now works with a computer firm.

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IVERSON'S LANGUAGE

Some More Functions

The series continues with an introduction to logical and character data

The primitives encountered thus far have largely been of the class DYADIC SCALAR FUNCTIONS ie functions like +, − which have two arguments and which operate on a component-by-component basis

THE SCALAR DYADIC FUNCTIONS

We have defined the more useful of these A few more follow without further explanation These are mainly of interest to mathematicians but are occasionally applicable

X|Y X residue of Y the remainder when Y is divided by X
X⍟Y logarithm of Y to base X
X!Y number of combinations of Y taken X at a time

In the following, consolidation exercise predict the result before checking it

EXCERCISE

```
1.    ¯1 ¯2 ¯3+1 2 3
2.     3 2 1÷8 9 10
3.     7 8 9×5
4.     6 5 4÷3 4 5+1 2 3
5.     5 ¯1 2⌊4 0 3
6.     10⌈12 8 0 23 15 9
7.     3⌊2*3 3 0 2⌊¯1 2 1 1
8.     1-3 8 6 5-1 2 0 5
9.     4⌈7 2 9 5⌊6
10.    5×1 3 6 8÷5
```

DATA TYPES

There are three types of data recognised by APL, numeric logical, and character Numeric data we have dealt with We will now discuss the remaining two types beginning with logical (or Boolean) data

LOGICAL DATA

In logic, there are two elements 'true' and "false In APL "true' is equated to 1 "false is equated to 0

We have encountered the relational function > briefly already For example

```
      9>10 8 7 12 9
 0 1 1 0 0
```

The result is a mapping which returns 1 if the relation is true, and 0 if it is false Note that ">' is a scalar dyadic function There are altogether 6 relational functions

```
      > ≥ = ≤ < ≠
```

meaning, respectively greater than, greater than or equal equal, less than or equal less than, not equal

CHARACTER DATA

APL handles character information with equal facility The appropriate functions to handle character data are the logical primitives which are discussed in the next chapter

A character constant or variable is defined by enclosing it in apostrophes, thus

```
      'ABC1 2377'
ABC1 2377
      X←'GEORGE III'
      X
GEORGE III
      ρX
10
      X+1
DOMAIN ERROR
      X+1
      ∧
```

When a character quantity is displayed, the defining apostrophes are not displayed and are not part of the constant or variable-it is merely a means of distinguishing character from numeric data

Whilst a space is not part of a numeric vector, it may be an element of a character vector or scalar

The only scalar primitives encountered so far which are usable with character arguments are ≠ and= For example,

```
      'A'='ASAEACARAEAT'
1 0 1 0 1 0 1 0 1 0 1 0
      ' '≠'HERE ARE THE SPACES'
1 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 1 1 1
```

These return a logical result mapping the occurrence of A' or the non-occurrence of a blank respectively

Any characters whatever may be used but the apostrophe itself must be typed twice, eg

```
      ρX←'ALF''S'
5
      X
ALF'S
```

MONADIC FUNCTIONS

Nearly all of the functions discussed so far are dyadic However there are a large number of monadic or one-argument functions – as well as monadic meanings for the scalar dyadics – which are very useful We present the more useful monadic functions below

INDEX GENERATOR

Next to ρ in general usefulness is ι (pronounced "iota) which produces a vector of natural numbers

```
      ι10
1 2 3 4 5 6 7 8 9 10
      ι3
1 2 3
```

The argument of ι is a positive integer (ι0 produces the null vector)

All manner of sequences may be constructed using ι Try the following exercise

EXERCISE

1 Using ι in conjunction with scalar primitives, form the following sequences

(a) 6 7 8 9 10
(b) 2 4 6 8 10
(c) 10 9 8 7 6 5 4 3 2 1
(d) 0 1 2 3 4 5

2 If

```
      X←'ASAEACARAEAT'
```

```
APL      |         ⍟    ÷ ×  ⌊          ⌈           −
ascii    residue   log  % #  D(or min)  S(or max)   ~
```

```
APL:    ≥  ≤  ≠  ρ(monadic)
ASCII:  ]  [  @  shape
```

use ⍳ to pick out the even-numbered elements

INDEPENDENT RANDOM NUMBERS

We have encountered dyadic query (?), which produces a random selection of integers without repeats. This is called 'deal' because it resembles the dealing of a pack of cards, none being repeated. Monadic query is termed "roll" and produces independant random numbers. It is called 'roll' because it resembles the independent rolling of dice.

As an example, enter

```
          ?6 6 6 6 6 6 6
    4 3 3 2 1 5 6
```

Roll is a scalar monadic function because it works on each number separetely, and returns the same shape as the argument.

Study the following examples, then try the exercise below. Deal, incidentally is very useful for constructing hypothetical but plausible data when you are checking an APL system.

Simulate the throw of two dice

```
          ?6 6
    6 3
```

Generate 10 random numbers in the range 0 to 1, with an accuracy of two decimal places

```
    [illegible]
[illegible]
```

(make sure you understand this example – remember the right-to-left rule)

Simulate a random sequence of length 20, of coin tossing, representing heads by H, tails by T

```
          'HT'[?20⍴2]
    HHHTTHHTHTTTTHHTTHHH
```

EXERCISE

1 As the last example above, but represent heads by 0 and tails by 1

2 Set up the vector ALF as follows

```
    ALF←'ABCDEFGHIJKLMNOPQRSTUVWXYZ'
```

Generate random words with five letters

SORTING A VECTOR

The function grade-up ⍋ (Δoverstrike |) returns the index set of a vector in increasing order. An example will make this clear

```
          X←9 3 4 5 7 6
          I←⍋X
          I
    2 3 4 6 5 1
```

Grade up does not produce X itself sorted, but the indices of X. Thus 2 is first

APL Series

because X[2] is the smallest element in X, and 1 is the last because X [1] is the largest.

The sorted vector itself is obtained by using I as the index set

```
          X[I]
    3 4 5 6 7 9
```

or, more concisely

```
          X[⍋X]
    3 4 5 6 7 9
```

EXERCISE

1 Sort the vector

```
    8.3 9.3 12.5 ¯4.8 9.2 ¯1.5 12.8
```

in decreasing order, using ⍒ (grade-down – ∇overstrike |)

2 The heights and weights of 10 individuals are given as follows

```
    HT←67 67 [illegible] 73 65 [illegible] 63 [illegible] 68 68
    WT←171 146 [illegible] 155 135 16[illegible] 115 153 176 [illegible]
```

sort the heights in order of increasing weight

ROUNDING TO THE NEAREST INTEGER

⌈ and ⌊, known to you already as maximum and minimum, have a monadic application, and are called ceiling and floor in this context. Monadic ⌈ rounds a decimal number to the next higher integer, and monadic ⌊ rounds down. Enter the following examples

```
          ⌈3.5 4.6
    4 5
          ⌊¯1.2 0.3 1.5 7.8
    ¯2 0 1 7
```

Probably the commonest use of these functions is to round to the nearest inte-

```
APL:      ≠ ⍳ ⍴(monadic)
ASCII:    @ I shape
```

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ger This is achieved by adding .5 and taking the ' floor

```
      X←3.6 9.4 7.3 2.1
      ⌊X+0.5
4 9 7 2
```

Taking the floor or ceiling of an integer leaves it unchanged viz

```
      ⌊1 2 3
1 2 3
      ⌈1 2 3
1 2 3
```

FORMING THE RECIPROCAL

The scalar primitives all have a monadic application We mention just one more monadic divide

```
      ÷⍳3
1 0.5 0.333333
```

ie monadic divide gives the reciprocal

Example

Using the formula 1/R= (1/R1)+ (1/R2) for resistances in parallel find the resistance for a circuit with R1=5Ω, R2=15Ω

```
      R←÷(÷R1)+÷R2
      R
```

MORE DYADIC FUNCTIONS

We conclude this article with a few more dyadic functions None of these is a scalar dyadic Recall that the characteristics of a scalar function are that its shape remains unchanged and it acts component-by-component

CATENATING VECTORS

Consider

```
      G←'FRONT'
      H←'BACK'
      G,H
FRONTBACK
```

The dyadic comma called ' catenate strings two vectors together Catenate is a very simple handy function

TAKING AND DROPPING ELEMENTS FROM A VECTOR

The dyadic functions take ↑ and drop ↓ do precisely what their names indicate Consider

```
      3↑X←'HOW ARE YOU?'
HOW
      3↓X
 ARE YOU?
      ¯4↑X
YOU?
      ¯4↓X
HOW ARE
```

'Take ' takes the indicated number of elements while drop drops the indicated number Take and drop are complementary If the left argument is negative as in the last two examples the indicated number is taken from the end of the vector Clearly, if a vector, X is of length say 20, then

```
      17↑X↔¯ 3↓X
```

(There is a tremendous amount of logical redundancy in APL)

If the left argument is numerically greater than the length of the right argument, the deficit is made up with zeros if the vector is numeric.

```
      X←9 5 6 3 2
      6↑X
9 5 6 3 2 0

      ¯6↑X
0 9 5 6 3 2
```

In the case of character vectors zeros are replaced by blanks as in the examples below

```
      NAME←'GEORGE'
      NEW←¯12↑NAME
      NEW
      GEORGE
      ⍴NEW
12
      (12↑NAME),NAME
GEORGE      GEORGE
```

in the case of 1 2 *NAME* there are 6 preceding blanks and in the case of 1 2 *NAME* there are 6 trailing blanks which of course are not visible unless we catenate something to the right

EXERCISE

1 Enter

```
X←3.7 ¯5.1 ¯4 ¯3.6 2 0 1.5
```

Now enter

```
      X=⌈X
```

The result is a 7-element logical vector Interpret

2 In the vector

```
      A←'ONE TWO THREE'
```

Select the middle word 'TWO' using drop only

DISTINGUISHING MONADIC AND DYADIC FUNCTIONS

In a compound expression such as

```
      4⍴(⍴X)⌈5+⍴Y
```

you may feel that distinguishing monadic from dyadic usage is a heroic task Actually it is very easy to tell the difference

> "If a function has another function on its left it is monadic otherwise dyadic

Let us illustrate with the above example

Scanning from right to left we first encounter

```
      ⍴Y
```

The next symbol on the left is "+ therefore ⍴ is monadic here

Clearly + is dyadic so that, in words

```
      5+⍴Y
```

is the number of terms in Y, plus 5"

The next significant term is ⌈ Is this monadic or dyadic? Since the next symbol – a right parenthesis – is not a primitive, ⌈ must be dyadic Therefore, we must find the left argument

Now, X is enclosed in parentheses so it is the left argument of ⌈ So far, in words,

Continued on page 98 ▶

```
         APL:       ↑    A-Z  -          ← ⌈(monadic) ⍴(monadic)⍴(dyadic)
         ASCII:     take a-z  '(grave) _ ceiling    shape      reshape

APL:      ⍴ monadic⌈(dyadic )                APL:     ⍴ monadic⌈dyadic ⍴ dyadic R Y
ASCII:    shape    max or  S                 ASCII:   shape    S or max reshape r y

APL:      ⌊          ⌈          ← ÷ ⍳                 APL:     ← A-Z ↑     ↓    -
ASCII:    min or D   max or S_  ≸ I                   ASCII:   _ a-z take  drop '(grave)

APL:      ← ⍳      APL:      ⍋       ⍒          -       ←     APL:     × ←⍋       A-Z
ASCII:    _ I      ASCII:    gradeup gradedown '(grave)_     ASCII:   ⌗ _gradeupa-z
```

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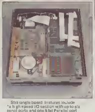

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MAGNETIC BUBBLE MEMORIES

This article, rather on the technical side, has been commissioned in response to requests from a large number of readers who are involved with the technology.

One of the major problems of present day computers is how to attain the economic storage of large amounts of data which [illegible] be easily and rapidly accessed. Semiconductor memories provide fast access but they are restricted in size, data is lost during power failure, they are radiation sensitive and high density memories are volatile, consuming power in a stand-by condition. Large amounts of data may be stored in magnetic tapes, discs or drums but these memory systems have long access times and contain moving parts which increase error, reduce functional reliability and limit the prospect of size and cost reduction.

Between these two extremes lies the Magnetic Bubble Memory. These memories provide high density storage (10^6 bits in^{-2}) giving four times greater capacity than semiconductors, with data access 100 times faster than other magnetic memories together with small size, lower error rate and higher reliability. Many of the technological requirements for their manufacture are already highly developed by semiconductor manufacturers, several of whom are entering the bubble memory market. The relatively slow development of bubble memories since they were proposed in 1967 by Bell Telephone Laboratories seems set to change in the 1980's with a projected market in the region of £200 to 300 million by 1985.

Magnatic Domains

The term 'Magnetic Bubble' refers to a small cylindrical domain in a thin film of ferrimagnetic material of diameter 1 to 1.2 times the film thickness. In thin films the minimum energy balance between magnetisation energy, quantum mechanical exchange energy and anisotropy (domain wall) energy is met by 2 domains which are spontaneously saturated with anti-parallel magnetic moments. These materials have uniaxial magnetic anisotropy with easy directions of magnetisation perpendicular to the film plane.

In the absence of a magnetic field the domains will form two interwoven serpentine patters as in Fig. 1 (a) one magnetised 'up' and the other 'down'. Applying a magnetic field perpendicular to the film causes the domain magnetised in the field direction to grow at the expense of the other Fig. 1 (b) forming irregular island domains in the 'up' direction. Increasing the field causes the 'up' magnetised regions to shrink into cylindrical 'bubbles' Fig. 1 (c). This formation can be used to represent a logic '1' and act as a data store. Further increase of the field causes bubble annihilation, the film becoming uniformly magnetised. Reducing the applied field below

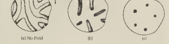

Fig. 1 *Bubble Formation*

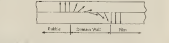

Fig. 2 *Spin Orientation in Domain Wall.*

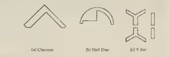

Fig. 3 *Asymmetric Propagation Elements*

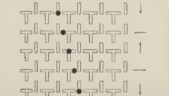

Fig. 4 *Bubble Propagation in T Bar Pattern*

[illegible] bubble to [illegible] strip out to the formation in Fig 1 (b)

Bubble domains are mobile and can be moved within the film since each bubble can act like a vertical bar magnet and will follow a moving magnetic pole There is no physical movement involved, the displacement takes place by a re-ordering of the sub-atomic spin moments causing a repositioning of the domain wall, Fig 2 Controlled movement depends on the bubble nucleation field being higher than the wall motion field so that spurious bubble generation is avoided. Interaction is avoided by keeping bubbles approximately 4 diameters apart

The commonly used materials are rare earth garnets of the form $N_3Fe_5O_{12}$ where N represents Yttrium Lanthanum, Samarium, Lutetium etc Substitution of Fe by trivalent atoms is used to modify the saturation magnetisation The rare earth constituents are tailored to give stable bubble domains with 1 to 5 μm diameter and doping with Calcium and Germanium helps stabilise the domain walls

Bubble Memory Structure

To use bubble domains for data storage methods of generation annihilation, detection and propagation must be provided

Bubble movement is controlled by a periodic pattern of nickel iron elements deposited on the surface of the garnet film. A rotating magnetic field is applied to these and causes them to form bar magnets whose direction of magnetisation changes as the field rotates This provides the moving magnetic pole which controls bubble propagation Currently asymmetric elements are favoured the dimensional changes give differences in magnetic flux density and aid bubble movement and transfer between elements Fig 3

Propagation is shown in Fig 4 using the T bar pattern Magnetisation is easiest in the long dimension direction, the strongest poles are therefore located at the end of the bars Rotation of the magnetic field causes the strongest pole point to move from one bar end to the other taking the bubble with it

Data is written into memory by the creation of a bubble when current is passed through a conductor formed under an element so that the local field strength reaches the generation level Fig 5 Annihilation can be achieved in the same way by use of a higher current level

Read out of data is currently achieved by bubble detection using the magnetoresistive effect The effective bubble field is increased by stretching the bubble into a strip domain in a special element section The bubble is passed beneath a line of electrically connected elements through which a current of a few milliamps is passing The magnetic field associated with the bubble causes a resistance increase in the conductor generating an output voltage of 10 20 mV Common mode noise induced by the propagation drive field rotating at 100 KHz is greatly reduced by connecting the detector in a bridge network with an identical dummy detector A replicator usually follows the detector to ensure non destructive read out

Memory Organisation

Specific applications such as flight recorders require sequential data storage and retrieval and these are catered for in a single loop storage format The very long access time to data at the far end of the memory chain makes this format unsuitable for most memory applications Access times of the order of 4 ms are obtained with a Major minor loop arrangement Fig 6

Data is read serially into the major loop and transferred in parallel to the minor loops The process is reversed for read out Access time is therefore greatly reduced the maximum number [illegible] the number of positions in the major loop plus the number of positions in the minor loop Large memory chips use two banks of minor loops (odd and even) so that the effective data rate is doubled Redundancy is also used to increase the yield small film defects having a devasting effect on bubble manipulation at the 1 μm feature sizes used in the element metallisation The Intel 1M bit memory has an error correcting system to improve reliability and a 48 loop redundancy Unused memory locations can be stored in a programmable ROM

Device Packaging

The complete device structure is complicated by the need to provide an accurately aligned in plane rotating magnetic drive field typically of 40 Oe and rotating at 50 KHz to 300 KHz Two orthogonal coils are commonly used fed by currents 90° out of phase Fig 7 The bias field needed to stabilise the bubbles is provided by ferrite permanent magnets A magnetic screen to protect the chip from external magnetic fields surrounds the structure in Fig 7 and the device is housed in a conventional DIL package

Support Chips

Bubble memories need a range of dedicated support circuits to perform chip control and interfacing A typical family of chips will contain

- 1 A memory control circuit to provide bus interface timing and control pulses and maintain memory address information
- 2 A sense amplifier which provides the output sensing of the two detectors maintain redundancy control provide error correction and act as a data buffer
- 3 A current pulse generator to provide the coil, sense and nucleate currents

Fabrication

Epitaxial films of the magnetic garnet are grown from the liquid phase on to a 3 inch diameter single crystal of non magnetic Gadolinium Gallium Garnet which is 300 to 500 μm thick Oxides of the required elements together with a suitable flux form the melt at approximately 1 000°C Following the growth the magnetic properties of the film are investigated with the aid of polarised light which

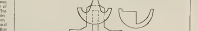

Fig 5 *Bubble Generation in Half-Disc Nucleator*

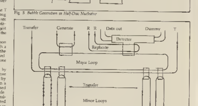

Fig. 6 *Major Minor Loop Architecture*

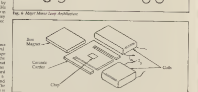

Fig 7 *Exploded view of Bubble Memory Components.*

delineates "up" and "down" magnetised domains

Ion implantations of impurity ions in very low concentrations are used to control domain wall structure and prevent untrolled bubble motion. A thin layer of Silicon Dioxide (Si O2) is sputtered on to the garnet film to act as a stress relieving layer between the garnet and metallisation. A layer of gold or aluminium is deposited on to the Si O2 and the conductor pattern obtained by a photolithographic process. A layer of photoresist (sensitive emulsion) is spun on to the metal coating. It is then exposed to ultra violet radiation through a mask which delineates the metal regions to be removed. Unexposed resist washes off during development and an Argon ion beam etch removes unwanted metal which is not protected by the resist.

A sputtered Si O2 layer is used to isolate the conductor and propagation element pattern. The nickel iron element pattern is formed in a second photolithographic process. A passivating layer of Si O2 is sputtered on to the slice and a photolithographic process with a hydrofluoric acid etch is used to open "windows" to the contact pads.

Storage

The devices on the wafer are probe tested in suitable bias and rotating fields and devices which do not meet the operating field specification are marked for rejection. The wafer is scribed and diced and the chips bonded on to an epoxy or ceramic carrier. Ultrasonic gold wire bonding connects the contact pads to lead out pins and coils, magnets and screen are positioned accurately around the carrier.

Fabrication is completed by encapsulation and generation of the correct bias field in the permanent magnets. A saturating field is applied under computer control and gradually reduced as device performance is monitored until the centre of the bias field margin is reached. Devices are finally tested over the full specification range and redundancy characterised.

The process steps required in the fabrication of bubble memory chips are fewer and appear less demanding than processes used in MOS memories. Dimensional feature generation is in the range 1-2 μm and registration of conductor and propagation elements is particularly rigorous, as is the final assembly.

Recent Developments and the Future

Bubble diameters used in current devices are of the order of 1 3 μm. With this dimensional limit 256 K bit memories are already in production and 1 M bit memories are under development, Table 1. The use of electron beam lithography, now becoming common in semiconductor memory processing, will provide line definitions allowing bubble diameters less than 1 μm to be achieved. Although production problems still exist, present trends indicate that 1 M and 4 M bit devices will be in use by the mid 1980's and operating speeds will have increased.

Developments being pursued include ion implanted patterns in the garnet fill to control bubble propagation; this will relax the alignment problems encountered in the present process in the same way that these techniques have improved MOS fabrication. Devices which operate without coils are being investigated and are expected to reduce cost and size and increase propagation frequency.

The projection of cost reductions for memory chips and their families of support chips is almost impossible. It seems certain however that these devices will begin to replace minidisk and other magnetic and semiconductor memories in process control, word processor, telecommunications and many other applications. This type of memory becomes more attractive as size and speed increases and the demands of microprocessor based distributed computer systems increases. ■

Dr J. Yates is at the Department of Electrical and Electronic Engineering, Polytechnic of the South Bank, London

TABLE 1 Some Currently Available Bubble Memories

Manufacturer	Material	Device	Package	Bit Capacity	Access Time MS	Transfer Rate (KHz)	Power (W)	Drive Field (Oe)
Texas Instruments	Y Sm Lu Ca Ge	TIB 0203 TIB 0303	14 pin 20 pin	92 K 254 K	4.8 7.3	50 100	0.7 0.9	40
BTL	Y Sm Lu Ca Ge			68 K		300	1.8	40
Fujitsu	Y Sm Lu Ca Ge	FBM 0102	18	64 K				40
Hitachi		BDG 0101	18	64 K	9.5	100	0.49	

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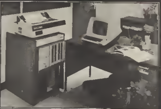

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But there is a limit to what you have time to do in one day. By the time you have arrived and registered, and collected the thick wodge of documentation, and then had the course director give the welcome and administration spiel, there is just time for the first speaker to wave a microchip and tell a couple of gee whiz stories – and it is time for coffee. After what is, in hotel terms, a quick lunch of about an hour and a half, and a few minutes for tea, it is time for the travellers from far off cities to put the free-issue mints and pens in their brief cases and start slipping away to catch trains.

It isn't of course quite as bad as that. But with the "Grips" program at least we thought we would try and make the very best use of the two days – not a long time to even mention all the things we want to say – and if you were going to pay us to teach you we had better try and give you your money's worth.

So we urge people to arrive *before* nine in the morning if they can. We arrive much earlier than that to get the ten or a dozen micros set up and running. And as soon as you come in you get a one-page easy guide to the PET keyboard and a step by step instruction on how to add two and two, or for the adventurous, to divide 22 by seven.

At 9.30 sharp it's into four short video tape presentations of the hardware and software to sidestep installing all the kit in the buyer's guide just for the day, and then an overview of the micro scene.

It is only an overview, but we look at programming, operating systems, analysis and design, and some management aspects. So it is not in great detail, but enough to give a flavour, enough to remove the mystique.

There are four hands on sessions using the PET. Why choose the PET? Because it is so easy to learn BASIC on the PET that we would be fools to bother with anything more expensive. Not that we teach the whole subject; you can still have hours of profitable education back at the ranch with the user manual. We teach a subset, and break it in gently. The complete course asks you to complete an instant three session; you can learn by the other fellow's mistakes too. Cover firstly calculation, then putting up comments and prompts, and to cycle round a loop. Thirdly to count things and take averages, and round off the results. And lastly how to save programs on cassette or disc and actually get them back in again, and to make it look pretty on the printer. Oh yes, and to read things from files and set up tables. Each person writes and runs four programs, and usually they work about the second time.

The formal sessions try and fill out the practical work. Starting at the actual coding, the talks spread outwards to relate this to the many other tasks to be done to set up a business system. We cover other languages and why people use them. How some are compiled and some are interpreted, and figure out some advantages of one method or the other. We worry about documentation and maintenance. And we look at a detailed specification and ask who should write it.

And before all this, someone has to set objectives. As there is no THEM or THEY in this world this means that you or I or even WE have to do this. Objectives are never the easiest things to set down. It is so much easier to duck the problem and to go out and just buy some hardware.

Sometimes, by this time, people are wondering why they bothered if there is all this fuss. Where is the miracle cure then? Where is the philosopher's stone? Maybe now some lessons are beginning to sink in.

But now the magic world of the Program Package. With its myriad pitfalls too, unfortunately. How to read the manuals, and try them out, and what to ask when you ring up an existing user to see if the program was indeed a solution or merely part of the problem. How much to pay. Is maintenance worth it? Are the programs any good? Instant answers, but are the answers relevant to your problem?

Two subjects around tea time on day two. Already it seems that we have been working together since the beginning of time; there is no world outside. Audit and security tells the nuts and bolts of how to back up files, and to prevent outsiders from taking a sneaky peek at your confidential data. And an insight into the world of word processing, communications and the electronic office.

We are very proud of this course. The format is similar to the sort of thing we have been doing with bigger computers for years, but now it is not potential DP managers or directors of data processing, but people out of far off branch offices and remote departments who want to get in on the act. Why do they do it? There are a lot more gentle courses. Are they masochists?

I think many managers feel they are getting left out of the micro revolution. It will pass them by as other departments, and other companies, and even their sons and daughters get into micros at school. They all seem so damn confident. How to catch up? It's a problem. Some people buy their own, but if you want it to do a little more than a calculator sized problem, it costs more than even most adult scale pocket money. To be encouraged to use a computer with cassette AND disk AND printer and to do some realistic sums. And in an environment where everyone starts equal and feels free to make silly mistakes too.

We normally get our complement of 30 people. The new series of "Grips" are filling up nicely, and we have one or two invites to bring the whole circus to individual companies. Quite a logistic problem this, but we have capacious motor cars.

What do people do with their new found micro appreciation? We don't know. We ought to get around to ringing everyone up and asking. But always the next "Grips" is upon us and there is no time.

So if any past participants are reading this, why not drop us a line to tell us how you are getting on? ■

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the electronic office

You may think that there has already been a revolution in the office – starting with typewriters and telephones, going on to calculators, copiers, telex and facsimile machines, culminating in today's business computers and word processors. But all that is only a taste of what is to come.

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*CP/M is a [illegible]

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HUMAN BEINGS FIRST

[illegible]

Resistance to change has little to do with age. I know many old men of twenty nine and a fair number of with it fifty year olds. It is a question of attitude rather than age.

A positive way of introducing employees to the merits of technological change is to introduce them to employees in another concern who have lived through the same qualms and fears. But in some companies the important first step is to ensure that everyone is speaking the same language. Some years ago, when British Airways were introducing various systems, one of their employees said to me "What is a computer?" – *after* she had learned that it was about to arrive on her work desk.

Today there are various training aids on the market that could help answer that question. One of the best I have seen is a film by Video Arts Ltd called "What is a Computer?" (Video Arts Ltd, 2nd Floor, Dumbarton House, 68 Oxford Street, London W1N 9LA. Telephone 01 637 7288, 01 580 0652, 01 580 0847).

Video Arts appreciate that most people may have learned to live with a computer but are still either in awe of it or slightly afraid of it simply because they haven't the foggiest idea how it works. The film is designed to lessen fear and dispel ignorance. It is specially designed for training staff who are coming into contact with the computer for the first time, or who work alongside it without really understanding just what it does or can do. It is an ideal cartoon film for induction courses, explaining the relationship between the central processing unit and the computer's peripherals – the video console, the printer, the card reader, magnetic tape unit and disc unit. It also deals with software and hardware preparation.

The film is a co-production with ICL and lasts 18 minutes. It is available on both 16mm colour and video cassette. The important point about it is that it does not go into technical detail and so does not lose its audience.

Unfortunately, films like "What is a Computer?" are rare and much of the educational material on the market is dull – drowned in detail, difficult to decipher.

This is even more true of reading matter. Among exceptions are the series of books of Computer Studies published by ICL, which are very well thought out and attractively written and illustrated. They offer further exploration of computing and are a suitable follow up to the Video Arts film. (Further information from Computer Education in Schools, 60 Portland Road, Reading RG3 1NR, England.)

Two more recent books, and suitable for management reading, are "The Micro Revolution" by Peter Laurie (published by FUTURA at £1 50) and "The [illegible] [illegible]isation" by Alan Burkitt and [illegible] Williams (published in hardback by W H Allen at £6 95). Both are written by journalists and are far less technical than many of the wares crowding the market, though they are not entirely free of jargon.

In the USA microelectronic technology is seen as an opportunity, in the UK it is seen as more a threat. That is why the way in which an organisation acquires the technology is as important as its choice of hardware. Giving employees as much information as possible, presented simply, encourages their acceptance of change. This may seem like common sense to the reader, but common sense is obviously in short supply in many companies where the system arrives unannounced, taking employees and their representatives by surprise.

Improved training and retraining is one of the six key demands which the European Metalworkers Federation (EMF), representing some 6 5 million employees in 15 countries, is urging its national affiliates to seek in collective agreements covering the introduction of new microelectronic technology.

This aim is set out in a new EMF "basic document" examined recently by a 25-man working party in Brussels. The other conditions that the EMF are seeking to impose are ▶

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- Worker control of production trends to offset a possible deterioration in working conditions
- Greater protection against dismissal
- New health and safety provisions to counter among other things alleged health hazards
- New job grading systems to establish wage scales

The document also calls for controls in the information that may be included in computerised personnel data systems and says that workers must have access to their own files Unions want to be involved from the start not after the event

The European Trade Union Institute (ETUI) set up by the Common Market to study labour affairs, recently published a 164-page report on the subject of technology The document criticizes those unions that have negotiated "no-redundancy agreements as the price of accepting new technology It says that no redundancy deals are by themselves simply a defensive strategy and may protect the employed workforce *at the expense of* the young people coming on to the market

The ETUI argues that the issue of what new products or services should be developed to offset job losses as the result of the "micro chip revolution' is a legitimate matter for unions to raise

The report examines the current state of new technology bargaining around Europe and trade unionists attitudes and draws a series of conclusions

Relationships

questions of new technology have allowed unions to raise associated issues (for example reductions in worktime) in bargaining

- a central objective for unions has been to avoid the downgrading of certain jobs particularly in the printing Industry
- technical advances increase opportunities for firms to monitor employee performance and record personal data – an area where the ETUI says union control is needed
- introduction of new processes raises productivity and it is deemed important that at least part of the benefit should accrue to those directly affected
- a number of unions are said to be concerned with the pattern of corporate ownership under which technology is introduced

In the Nordic countries for example the possibility of increased employer control of the workforce through the use of new technology has become a matter for intense debate The Nordic Council of Trade Unions has declared that under private ownership companies have but little incentive to match increases in productivity with increases in employment and has called for a system of worker share ownership as a method of obtaining a say in the spread of new processes

As Union concern grows in the area of new technology and change this will strongly affect their attitudes towards its introduction in organisations We are already witnessing this in UK industry What must be avoided is management merely reacting to such a change as a result of outside pressures and demands The increasing role of managers is to initiate change to lead and motivate

When considering change in an organisation the first principle is to make sure that everyone knows what you are talking about At the end of the day it does not matter what *type* of change is being advocated it is the way that it is introduced that will really affect the situation

In the next issue I shall discuss how this has been achieved in an organisation where people did not easily resign themselves to a change of regime ■

- *Lynda King Taylor is [illegible] for Business* Computing

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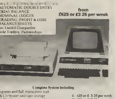

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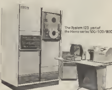

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Part II: Analysis of Change

In a previous article it was emphasized that the basis of control is information in the hands of a manager Arising from our discussion so far are some important issues but their explanation is postponed until we have understood the meaning of control in cybernetics

Applications of control in management situations may be classified as commonly appreciated and moderately appreciated Some examples of each type are as follows

Commonly Appreciated	Moderately Appreciated
Stock Control Production Control Budgetary Control Strategic Control Quality Control	Various social and psychological controls which operate at individual group and organisational levels

Moderately appreciated controls are often least formalized in an organisation although they are as essential as commonly appreciated controls However it is rare for some control system to be absent in organisations whether these systems exist by intent or not The goals of an organisation might not be made explicit or might be interpreted in unintended manners there may be ill defined and misunderstood measures of performance and an inconsistent reward system for satisfying members of the organisation who operate it And at the same time there might be general agreement that everything is under control

At this stage notice that a control system involves the application of *feedback* mechanisms which have been developed to a high degree of sophistication One of the most important concepts of cybernetics is feedback or as it is better termed mutual causality Cybernetics is concerned with the use of information and feedback to control *goal seeking behaviour*

Let us first consider a general example which applies to all of us We are well aware of the fact that often in all walks of life optimum solutions to our problems are not always attained at the first attempt (if ever) We use all kinds of exploratory means in our search for the best solution(s) These methods guide us towards the right direction so that our *goal* can be realized

The idea of goal seeking implies there is a specific target to achieve and towards its attainment we have to interact with the world around us The interaction implies here that we have to perform some activities so that our set target can be met We may at regular intervals have to evaluate our *performance* and *learn* (gain information) how far we have made progress towards the attainment of our set goal The *information* about the degree to which the set goal has been fulfilled is known as *feedback* information We compare the actual state of our goal with that of the desired state (target) Their difference indicates the amount by which the task accomplished differs from that desired (target) The difference is known as *deviation* or *error signal*

This comparison enables us to act in such a way that our efforts can minimize this difference The cycle can repeat itself until the difference or feedback is minimized and the target is considered as achieved We use principles of feedback in many of our physical activities For example the rider of a bicycle receives feedback in regard to direction and balance which causes her or him to take corrective actions

It should be remembered that the word control' is not used in management cybernetics in a coercive sense or as a synonym for complete dominance but describes the systematic direction and integration of efforts towards the achievement of a goal under the constraints imposed by the environment

Any problematic situation may be viewed as a cybernetics situation if it has three essential elements namely

- **goal directedness**
- **control actions**
- **environmental disturbances**

Day to-day management problems are concerned with such situations in which control actions are involved in the interpretation and evaluation of information regarding the actual performance of the system and are also concerned with directing the corrective action needed to maintain the system output at the desired state Quantitative measurements of the actual performance and then comparing these with the *predetermined criterion* may be necessary

Most people tend to think that control is some form of action which is taken after the emergence of some facts about the behaviour of the system which is designed for the attainment of a set goal But in ▶

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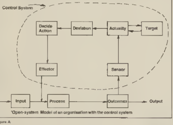
cybernetics terms [illegible] control exists when the system operates in such a way that it is not only consistent but also able to operate in a manner such that it counteracts any disturbances in its internal state which may be due to either changes in the external environment or the outcomes of the action of the system itself. Thus it is vital that the information about the behaviour of the system for which the control is designed is fed back into it and that it adjusts its behaviour as a result of this information. In this way a position of equilibrium which Ross Ashby* calls the state of *homeostasis* is maintained in the system.

A control system based on '*homeostasis*' consists of several components, shown in Figure A and labelled 'control system'. Figure A is based on our earlier discussions of messages and processing of information. Now we have developed the concept of feedback which is shown in Figure 1 and have incroporated it in the 'open-system' model of an organisation.



'Open-system' Model of an organisation with the control system

Figure A

We consider an organisation as an 'input-output' system which is continuously in interaction with its environment and maintains a dynamic equilibrium. The organisational mission (goal attainment) will not be possible without a continuous inflow, processing and outflow of information.

Briefly, the control system receives information through the sensor about the system's actual performance which is known as actuality. Stored within this control system is a target. The control system determines the discrepancies that exists between the target and actuality. This we refer to as deviation. The control system then selects action that will reduce this deviation. This action is implemented by an appropriate effector. As shown in Figure 4, the control action in the form of information will become the part of our continuous input output information processing system.

Summary

In this article I have attempted to analyse the concepts of information, communication and control as applied to business management. In doing so, I have avoided, wherever possible, the use of technical terms; to help the reader I have selected practical examples. I have not defined any of these concepts but it should be noted:

- **Information is flow**
- **Control is a regulator which involves feedback information**
- **Communication is interaction which embodies both information and control**

The reader may recall that the fundamental theme of management cybernetics is regulation and control in open systems such as business enterprises. With the rapid growth of technology, the expansion of economic markets in the third world and rapid political changes on the international scene, come constant pressures for organisations to change, adapt and grow. And it is not merely some key individuals who must learn to change, but it is the total organisation which must:

- learn to make a response to a stimulus such as the energy crisis, which was not anticipated when the system was designed
- renew and safeguard itself against internal breakdown and error
- perceive continuously the state of the external environment (customers, suppliers, economic conditions etc) and the degree of integration of the internal environment (individual needs, organisational goals) in order to survive in conditions which were not foreseen by its designers

Knowing that every business system has multiple functions (buying, selling, data processing etc) and acknowledging that every business system operates in the environment that provides unpredictable inputs (people, materials, information etc), a business system or any other social organisation's effectiveness should be viewed in terms of:

- its ability to survive
- its ability to adapt
- ability to maintain itself
- ability to grow regardless of the functions it fulfils

Thus in the presence of constant critical changes in the environment, one raises some of the following important questions concerning the analysis, designing and functioning of an organisation:

- Can effective organisations be designed or do they evolve?
- What determines the stability (ultrastability) of an organisation?
- What central structures are appropriate for controlling the organisation?
- What effective inter-departmental information channels exist?
- What information does an organisation require and how should it be processed?
- What are the information communication channels between the policy makers and peripherals of action (shopfloor, office etc)?
- What mechanisms exist for converting messages into information, particularly about changes in the environment, into changed operations?
- Is the internal environment flexible enough to cope with changes?
- How does an organisation maintain effective interaction with its environment?
- How can the organisation's efforts at coping be improved?
- How are decisions made and are these decisions communicated to the right person at the right time?
- How can an enterprise survive in the face of critical changes in its environment?
- Is the effectiveness of the organisation judged by its performance on one function such as profit maximization or on some integration of the several functions?
- What mechanisms exist for sensing changes in the external environment and communicating these to those members of the organisation who are in a position to do something about it?
- How does it solve problems that confront it now and how will it tackle new problems that will emerge as the organisation grows?

At this stage, it should be noted that a business system or any social system can not be regulated from within.

Since homeostasis or self regulation is one of the essential characteristics of living systems as well as business systems, it implies that many of their activities are regulated by means of negative feedback which was discussed in the last article.

Without entering into the debate of open and closed systems and their respective properties, I should briefly mention that all living systems (people, plants

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* Ashby, W R (1956) *An Introduction to Cybernetics*

) are open systems Other systems (machines clockworks) are closed systems but the addition of feedback mechanisms provides them with some of the properties of living systems which are related to their 'equilibrium state

Business Organisations as 'Open Systems'

Traditional management thinkers viewed business organisations as closed systems i.e. self contained and attempted to analyse the organisation in terms of its internal environment (structure tasks and formal relationships) Thus the organisation was considered as independent of the external environment However this thinking has been replaced by systems and cybernetic thinking in which an organisation or a social system is considered as 'open system Miller (1965) defines an open system.

> Most concrete systems have boundaries which are at least partially permeable permitting sizeable magnitudes of at least certain sorts of matter energy or information transmissions to cross them Such a system is an open system In open systems entropy may increase remain in steady state or decrease.

In simple terms an open system has an environment – both internal and external It continuously interacts with its external environment For example a business organisation receives its various inputs (supplies from numerous companies, information on marketing from various sources etc), processes these inputs in some way and sends outputs to the external systems (goods to customers information to bank etc) In addition to this it consists of sub-systems (sales production etc) which interact with each other, and their behaviour influences the overall objective of the enterprise Thus the internal interaction affects the system as a 'whole

Bertalanffy (1962) suggested the following main characteristics of open as compared to closed systems which are

- open systems will attain a steady state which is characterised by the principle of equifinality this in contrast to equilibrium states in closed systems which are determined by initial conditions and determined only the the system parameters
- open systems through import of negative entropy can maintain themselves and even evolve towards an increase of order and complexity

Katz & Kahn (1966) point out: to survive open systems must move to arrest the entropic process, they must acquire *negative entropy* The entropic process is a universal law of nature in which all forms of organization move toward disorganization or death the open system, however by importing more energy from its environment that it expends can store energy and can acquire negative entropy There is then a general trend in an open system to maximize its ratio of imported to expended energy to survive and even, during periods of crisis to live on borrowed time

The concept of *entropy* was borrowed from thermodynamics where it is a measure of disorder of elements in physical systems In systems and cybernetic theory it has been generalised to mean the degree of organisation of a system The application of this concept in open systems has been developed further by researchers including Bertalanffy (1950), and Katz & Kahn (1966) and it is known as negative entropy According to the Second Law of Thermodynamics the system will move in the direction of maximum entropy that is there is greater randomness of the elements over time Kast & Rosenzweig (1970) point out that the tendency toward maximum entropy is a movement to disorder complete lack of resource transformation, and death

At this stage it suffices to say that feedback mechanism is of paramount importance for any organisation in order to

- acquire negative entropy
- exhibit equifinality

The principle of equifinality suggests that open systems (business organisations, universities etc) possess the following characteristics

- Unlike closed systems they are not wholly dependent upon their internal conditions
- by virtue of their interaction with the environment their objectives can be accomplished from different initial conditions
- their objectives can be satisfactorily accomplished in different ways But in the case of closed systems there is only one 'best way' for achieving a given objective This is due to the direct 'cause and effect' relationship between the initial conditions and final state of any closed system
- they maintain their steady state or dynamic equilibrium unlike the closed systems which maintain their equilibrium which is of a static nature

Negative & Positive Feedback

In the previous article it was stated the information about the degree to which the set goal has been fulfilled is known as feedback We compare the actual state of our goal with that of the desired state (target) Their difference indicates the amount by which the task accomplished differs from that desired (target) The difference is known as 'deviation or error signal Figure A demonstrates the control mechanism for the homeostasis conditions which is actually an example of *negative feedback*

Negative feedback is meant to reduce the difference between the output of the system and the predetermined criterion Thus the control action decreases the error between the actuality and the target

For instance the quality control department in a manufacturing company is responsible for examining the products and making sure that the goods made do not leave the factory gates without satisfying the standard laid down They must pass the quality test and be error free In industry control systems may not always be of a homeostatic nature but the ideal control should have this type of regulating system

Positive feedback occurs when the action of the control system increases the response difference The following examples will help the reader to appreciate this concept

Assume that two senior managers of a large company who have been working for Happy Limited over the last ten years have opposite personalities but both get on very well with the managing director The managing director values their services but he is concerned about the uncertainty of messages between their departments In his view these two departments do not respect each other's views This situation may also be due to ill defined boundaries between these departments

In order to resolve the matter the managing director asked the company's secretary to arrange a meeting between the disputed parties and act as a mediator The meeting between the secretary both senior managers and their respective immediate deputies took place and progressed very well for the first fifteen minutes or so Suddenly, one crucial point in the discussion widened their differences and no compromise was reached for the restoring of a good working relationship The secretary s report to the managing director indicates positive feedback as the difference has been *widened* instead of reduced

Another much quoted example of positive feedback is a growth economy in which increased profitability is ploughed back further to increase profitability

Finally consider the case of teacher training colleges which produce trained teachers who go back to teacher training colleges to produce more trained teachers

It will suffice at this point to emphasize that the positive feedback usually leads to system instability whereas negative feedback provides stability

Mutual Causality or Feedback Loops

Mutual causal relationships of feedbacks in information processing and analysing the interrelationships between a number of elements in a system under investigation provide a very useful method for identifying how they influence each other in the loop The following examples will help the reader to understand the main features of mutual causality

Let us assume that XYZ Limited has appointed a new sales director who has increased the sales campaign – advertising in the national newspapers trade journals and on television This effort has led to

- an increase in advertising company s products which in turn causes
- an increase in demand rate for the company s products which in turn causes
- an increase in the sales of finished goods which in turn causes
- an increase in the sales revenue which in turn causes
- an increase in the advertising as more money is available for this purpose

▶

In short an increase in advertising causes a further increase in the advertising campaign through demand rate, sales and sales revenue

Now look at the Figure 1a which shows this phenomenon diagramatically It should be noticed that in the loop A-SR-S D each element has an influence on all other elements either directly or indirectly and each element influences itself through other elements It is in this sense that we understand the mutual causal relationships between two or more elements in a loop

Arising from the above discussion are the following important points

- the **change** *amplifies itself* positive feedback in this loop has caused an *increase* in each element On the other hand it the loop had contained a *decrease* in each element, *the change would still have been amplified*
- the information feedback to the decision-makers about the current state of the market enables them to compare it with that of the desired state and take action accordingly However in many companies the sales budget is directly related with sales turnover and results in a change in the sales activity that is undertaken
- such positive feedback loops tend to have destabilizing effects (this is not always the case as positive reinforcement is essential in all sorts of learning)

This example is oversimplified as it does not show how other elements in the system interact and influence the whole situation My purpose here is to demonstrate the main feature of mutual causality relationships involving positive feedback loops, and how they operate without the presence of other interacting loops In short, it can be concluded that in the absence of

- guiding policies based on the information feedback to decision makers about the marketing situation
- constraints imposed by both the internal and external environments
- interactive negative feedback loops

the positive feedback loops make the system as a whole unstable

But in general a business system is a viable system in which a dynamic equilibrium is maintained This implies that in the system there will be other interacting loops which will attempt to *stabilize* the whole situation In this case, the loop DT D-FG-OB as shown in Figure 1b will interact with the loop A-SR S-D of Figure 1a in an attempt to stabilise the system It is interesting to note that the positive loop turns anti-clockwise, and the negative loop turns clockwise

In the light of what has been said about the increase in the demand rate for a company's products which is caused by an increase in the advertising assume that the increase in the sales is of such a large magnitude that

- finished goods stock is running out much faster than the manufacturing and assembly processes can maintain at the desired level
- in spite of the manufacturing and assembly plants overstretching their production capacity, the stock of finished goods has almost run out
- a backlog of orders has begun to build up due to a bottleneck situation
- the delivery time has lengthened

Within the framework of this discussion and in relation to Figure 1b, this present situation can be interpreted as follows

- an increase in demand rate causes a decrease in the finished goods stock
- which in turn causes an increase in the order backlog
- which in turn causes an increase in the delivery time
- which in turn causes a decrease in the demand rate

In short an increase in the demand causes a decrease in the demand through a decrease in the finished goods stock an increase in the order backlog and an increase in the time taken to deliver goods In this loop therefore any change in the demand rate is *counteracted* by itself

In the long run such negative feedback loops tend to stabilize the system However

- customers will react to the long delivery time by placing orders with some other suppliers or perhaps buying other substitutes
- when the delivery time is more acceptable to customers the demand rate may increase
- over some considerable time the demand rate approximately equals the capacity of the manufacturing and assembly plants which in turn stabilizes the whole situation

Figure 1c shows the network of feedback loops A SR S D and DT-D-FG-OB In this figure, the linking variable is the demand rate These two loops interact with each other in such a way that the elements in these loops influence each other either directly or indirectly and also influence themselves through other elements I should like to emphasize here that this network represents an oversimplified situation that existed in more than one company with which I was associated recently as a consultant

Now consider another example which is illustrated in Figures 2a 2b and 2c

Briefly Figure 2a can be interpreted as

- an increase in the industrial investment causes an increase in the improvement of the state of the economy which in turn causes an increase in the job opportunities which in turn causes an increase in the number of people at work In other words, an increase in the industrial investment causes further increase in the industrial investment through the improved state of the economy more job opportunities and fewer people out of work

Similarly, Figure 2b can be interpreted as

- An improvement in the economy causes an increase in inflation, which in turn

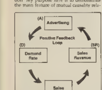

Figure 1a Positive Feedback Loop

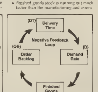

Figure 1b Negative Feedback Loop

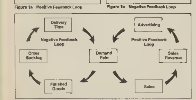

Figure 1c A Network of Feedback Loops of Mutual Causality

causes a decrease in satisfaction in the society which in turn causes an increase in the wage demands which in turn causes a deterioration in the state of the economy In other words an improved economy causes a deterioration in the state of economy

Figure 2c like the Figure 1c illustrates the interlocking of the mutual causality loops as discussed above I have discussed the validity of Figures 2a 2b and 2c with my colleagues who are economists and they have pointed out that this is only a point of view and that in economics most theories can be refuted However, my purpose in using a socio-economic model is to demonstrate the interactions between the feedbacks which can help the decision-makers in their planning The concept of mutual causality demonstrates that simple rules can generate a structure of vastly increased complexity, and also that the initial stimulus can be very important to the final result

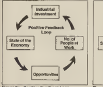

Figure 2a Positive Feedback Loop

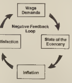

Figure 2b Negative Feedback Loop

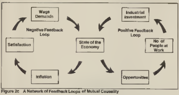

Figure 2c A Network of Feedback Loops of Mutual Causality

Finally, consider the next example which brings about the distinction between 'mutual relationship and the mutual causal relationship between two or more elements

'Mutual' and 'Mutual Causal' Relationships

Let us assume that ABC & Co are manufacturers of ladies garments for the age range 16 25 years and XYZ & Co are manufacturers of threads and also have some retail outlets for young people s clothing ABC buys its threads for sewing clothes from XYZ XYZ buys garments for its retail outlets from ABC

Thus there is some *mutual relationship* between the two companies But suppose that XYZ buys garments from several companies Whenever due to industrial action or other reasons ABC's industrial output drops XYZ s purchase of garments for young people from other companies increases When ABC s industrial output goes up XYZ s purchase from other companies decreases The volume of threads XYZ can supply to ABC does not depend on the numbers of garments XYZ buys from ABC Furthermore, ABC has other customers besides XYZ Whether ABC buys or not from XYZ and vice versa, does not affect their operations very much because both companies have other customers besides themselves

At this stage it should be noted that although there is a two-way traffic of goods between ABC and XYZ yet the numbers of garments and the volume of threads have no mutual causal relationship

Now assume that fashion' has suddenly caught up with young people and both garments and threads are in great demand Consequently both ABC s and XYZ's industrial outputs have simultaneously increased This simultaneous increase is not caused by a mutual causal relationship between ABC and XYZ but by a third element which is fashion

It raises an important question What are the necessary conditions for a mutual causal relationship between ABC and XYZ?

For a mutual causal relationship between ABC and XYZ the following conditions are necessary

(i) ABC s industrial output depends on the industrial output of XYZ and vice versa and at the same time

(ii) ABC s industrial output fluctuates with the XYZ s industrial output and vice versa This fluctuation may be either in the same or opposite direction

Maruyama Magoroh (1968) has developed this concept as applied to many social systems J W Forrester and his co-workers have developed computer simulation techniques for modelling such feedback interactions which they call systems dynamics modelling They have applied these techniques to industrial urban and world systems and have been able to draw a number of interesting conclusions The reader is advised to consult a copy of the "Limits to growth" by D H Meadows, published by Earth Island London 1972

In summary, it should be agreed by now that as an open system an organisation is embedded in its environment which is changing continuously due to many factors such as firms amalgamating and international activities leading to socio-economic problems An organisation then largely depends on importing information from its wider environment in the form of information feedback which it should analyse carefully at the appropriate time The time factor is very important in analysing and making use of the information arriving and generated internally by feedback information systems

In the changing environment, an organisation can survive through a change of structure and behaviour which has been called ultrastability' This and other related cybernetic ideas as applied to business management will be discussed in the next article ■

■ *To be continued M Saeed Sheikh M Sc Dip Org Ps Cert Ed AIDPM is a management cybernetician and consultant*

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COMPUTER AID KITS FOR BUSINESS FIRMS

In computer animation there are several aid kits for carrying out computer drawings whether they are for educational purposes or work in the engineering medical and architectural fields They are usually very useful but few aid kits have been supplied for business firms who are either in the process of installing a computer system or wish to keep their present system up to date

But now a small British company of computer professionals located on the Hampshire coast is marketing individual aid kits that cover practically everything from the organisation of a business firm s activities through to the technical aspects of a project The firm is Simpact Systems Ltd of Southampton who have been in operation since 1975 During that time they have trained over 1 200 students from more than 100 countries

Students can be sent for half day Appreciation Courses or for a 5 day stay One of the well known companies which has participated is British Petroleum but the system can be tailored to the needs of small businesses When called upon Simpact will attend a client s premises and work on site with computer staff

One of the advantages Simpact offers is a practical implementation kit to which managers can refer to as data Records are moved into computer-based information systems The resultant techniques [illegible] kits are applicable to all types [illegible] cial operations and hold good [illegible] computer hardware is installed

Simpact has defined the life style of an information system as having three sub cycles

The first they say is Planning which covers strategic planning of the information system and includes a feasibility study

The second is Development That is the solution to the problem outlined in the feasibility study is implemented and made operational

Thirdly Operation itself Once the system is operational it is managed maintained and enhanced as required

The Hampshire company has devised standard approaches to achieve each requirement

The system goes under the name of Prompt which is short for Project Resource Organisation Management and Planning Techniques The principal concept in Prompt is to differentiate between the business aspects and the technical aspects of a particular project

Business aspects are concerned with the managing monitoring controlling planning and co ordinating activities of running the project

The technical aspects include specification design completion and test documentation That is to say those activities concerned with building the end products This concept determines the remainder of the Prompt framework and the structure of the various components

Prompt divides the project development cycle into six stages each having one or more precisely defined end product

The first is Justification That is a demonstration of the financial case for the project Secondly comes Specification that is detailed requirements from the user together with his accepted criteria Thirdly comes Design or the solution to the specification

It then goes on to Development which is a construction of the solution this includes a complete system test That leads on to Installation In other words the preparation of the user s environment to accept the new system into installation and testing the accepted criteria Finally comes the tuning of the solution to achieve optimum performance

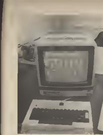
Prompt recognises five common components within each stage The first Simpact places under *organisation* which means top level control for a project by the Project Board – three people representing the interests of project funding the user needs and the development expertise Prompt also clearly defines roles for project management end product creation and quality control

It also provides a total *planning structure* covering all business and technical aspects It goes further and describes the *content purpose* and *timing* of each plan The size of each project determines the number of plan levels and the amount of detail needed in any particular plan

In order to retain business and technical integrity the system provides a structure of controls which are applied to each of the defined stages These controls apply to all aspects of project activity and at the highest level allow top management to review project performance to date before committing itself to further project expenditure in any subsequent stages

There are four types of control which include the End Stage assessment a mandatory presentation to the Project Board at the end of each stage It covers the current project status together with the budget for the next stage The Mid Stage assessment is a similar control but is not

Project Ma[illegible] [illegible] with the [illegible] do [illegible]



S[illegible] on micro computer dis[illegible] [illegible] Prompt's Plan [illegible] [illegible]

mandations. It is used at intervals during long stages and to relate completed items to the next stage [illegible] total completion of the current stage.

What the company describes as Milestone [illegible] technical quality [illegible] control procedure for all end products. Stage end small. Checkpoints [illegible] business status control which [illegible] complete [illegible] [illegible] for the project [illegible] consideration.

Aids

Activity checklists are provided for the work to be done in each stage cross referencing in each case to the end product and the documentation necessary to be produced. A separate series of checklists identifies the manager's own activities during the stage. Full documentation including that for planning and control is built up during the project cycle.

For each new project a manager receives a brand new personal kit tailored in each case to the size of the project. Each kit provides a comprehensive package of plans, checklists, procedures and forms to guide and support the manager through out the total project cycle.

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Eileen Phillips

OFFICE ORGANISATION AND TECHNICAL INNOVATION

There was a perceptible change of emphasis at this year's Online International Word Processing Conference. The business world was no longer being sold the latest technology as a means to cut typing and clerical staff, but was challenged to re-think the organisation of their office systems as a pre-requisite for introducing innovations varying from the electronic typewriter to an entire communications network. The favourite horror story was of a company which had introduced word processors and reduced their secretarial staff by two-thirds. After a year a check had been done on the benefits of the changes and they were staggered to discover an *increase* in managerial staff of 50 per cent, who were being paid high salaries to do proof reading for spelling and punctuation!

Two major questions were discussed in the context of re-structuring systems of information processing: firstly how to build a system which would generate new uses as well as dealing with present needs (and so could not be proved in on a simple cost benefit basis) and secondly how to ensure user co-operation in both planning and implementing the system.

To take the latter area first. One of the most interesting sessions included Norma Klinger, Co-ordinator of Administrative Support Services, Texaco Ltd, taking us through the changes she had introduced in their secretarial services. Three years ago a study of the company's secretarial support had shown the majority of secretaries being used as "go for's" (eg go for files, sandwiches, birthday presents) all isolated from each other and unable to take on work from another department, so temps were continually being employed to shift bottlenecks.

Norma Klinger isolated three possible choices they had: assigning a word processor to every secretary, which, given they spend only around 24 per cent of their time typing would have been very wasteful; setting up a centralised and therefore impersonalised typing centre, which she predicted would have failed because of dissatisfaction on the part of both managerial and secretarial staff; and having smaller centres spread throughout the company which would allow human contact both between the secretaries themselves and also between secretaries and executives. "When it was a question of human relations versus efficiency we went for the former," Norma Klinger emphasised. "When you've got a one to one secretarial system it can't just be thrown out. The system would go down. We went for a compromise and now have six centres with six supervisors rather than only one so we've sacrificed a lot."

Although Texaco has the resources to avoid cutting corners on costs, the issue of productivity remains relevant. As Norma Klinger pointed out: "No-one had examined secretarial productivity before so we were onto a winner." But winning or losing aside, how do the secretaries themselves respond to their work being put under an O & M (Organisation & Methods) spotlight, given that it was acknowledged from the start that they would rebel if shunted into an anonymous typing pool?

The correspondence secretaries are asked to note in a log the status line on their screens at the last line of the text. These logs mean a comprehensive monitoring of both workload and types of work produced is possible. I was surprised to discover when talking to Norma Klinger that the secretaries liked this because they felt both proud of the increases in their productivity and glad that attention was being paid to their work. This acceptance is obviously furthered by the lack of any trade unions at Texaco but it can also be linked to a change in the promotion structure. Previously a secretary experienced promotion as her boss moving up the hierarchy took her with him. Now secretaries are divided into correspondence and administrative secretaries, the first group need to pass a proficiency test in order to work in a centre, for the second group there is both the possibility of moving up the new structure which Norma Klinger now heads and the chance of taking on certain executive duties.

It was not clear whether a correspondence secretary could become an administrative secretary but it is recognised as crucial to keep them in the same room in order to encourage co-operation between the groups. Norma Klinger insists they are different but equal in their importance to the company. She sees it as significant in gaining their co-operation that there is now, for women entering the company, a parallel possibility to the male clerk becoming managing director.

Ray Curnow remarked when discussing the effects on the manpower profile of the automated office: "If I was of the opposite sex I would go for Word Processing administration because this is a growth area." These changes in career structures for secretarial staff were borne out by Sylvia Baxter from Pedigree Petfoods and Margaret Organ from Macfarlanes solicitors, who described similar experiences to Norma Klinger's, all three women having started out themselves as secretaries.

Sylvia Baxter re-iterated the need to take seriously staff involvement in any changes, not only by discussing plans in advance but also by getting their ideas for improvements. She told us "You'd be surprised how many ideas there are lurking under the surface once you get the girls there and ask them. I think they didn't believe their ideas would be taken seriously. We've had to let events prove them wrong."

Staff participation in designing new systems is a central plank of the prescriptions of Gordon Ross, who has recently moved to Logica from the Work Research Unit. He includes everybody in this from the director, O & M, Data Processing, line managers through to clerks, secretaries and typists. He is not naive about the difficulties of getting such a range of people to work together but argues that the pay-off can be an integrated system which works—and renders irrelevant the feuds between different departments. But the fears of managerial and professional staff, that attempts to raise productivity in the organisation as a whole will mean their own output is examined, can be a barrier. After all they often compose the highest cost factor in the running of a business.

A danger Ross insists has to be avoided is any simplistic cost analysis approach where, for example, a system's effectiveness is solely measured by counting the number of keys a typist presses. A new system can mean that instead of having typists there are clerks with on-line system back up, which in itself cannot be compared quantitatively with the old system.

In the experienced-user forum John Day from Allen & Overy, a firm of solicitors, described how difficult it was persuading certain executives to accept the new system. "The general reaction from the principals, despite strong factual evidence to the contrary, was that they never needed to make editorial corrections to their work since it was always right first time, and since they never repeated themselves, all their work being entirely original each time, the ability to record and duplicate work at high speed was useless. This problem is significant not solely in terms of gaining user acceptance but also in relation to future developments of a system It is clearly necessary to design new systems rather than seeing a way forward as simply automating the old But more than this, the new system once installed has to be continually worked on So for instance at Texaco monitoring the administrative centres give a check on how much one-off work is being produced Then attempts can be made to decrease this proportion through discussions with managerial staff As Norma Klinger pointed out Like any computer system it will go down unless you work on it and develop it' At present Texaco have stand alone word processors but the structural framework has been set up for advancing to more integrated systems

The second major area of debate – how to construct dynamic expandable systems – generated one of the most heated discussions This reflects that oft lamented propensity of British management – hanging back from major investment drives The issue here is not so much being slow at taking up the new technology – it can be argued that scepticism in the fact of manufacturers sales talk is a healthy quality particularly when last year s models are already outdated – but rather that innovation should be seen in the light of company *growth* not solely an exercise in cutting overheads

John Kelly from BL Systems Ltd described the communications system which is being installed in two stages at BL The

Conference Review

first stage having got everything onto a digital system involved putting in a plant loop which allowed like to talk to like throughout the different sites of the company The second transport systems stage meant installing switches so that for instance a word processor could communicate with a telex system The system has taken four years to develop It could not have been introduced on a direct accounting basis of cost justification. An example he gave was that of choosing between plugging in two communicating places on the loop and having a P O private line It may be that at present the calls between the two points cost £5000 and a private line would cost £2000 – but there may also be hidden uses which, until the interested parties are shown the possibilities they remain unaware of Mr Kelly explained A Word Processing manager in Burnley may think the only necessary communications is with a Word Processor in Birmingham but when presented with a diagram may think 'Well I d also like 20 minutes a day time sharing on this computer here

Some of the audience at this point flung up their hands in horror But the argument was obviously pertinent to an economy which (as the chairman Derek Portch pointed out) could fall further into recession It is interesting that these advances at BL in terms of communications are mirrored by a new push from Xerox Digital Equipment and Intel to challenge IBM s hold over the market Th y are co operating to produce a communications network Ethernet which can link different business machines both internally and between sites At present IBM can rely on customers buying their products when they expand their systems because these will be technically compatible with others in the range But the three companies see the future of the electronic office as dependent on producing networks capable of diverse link-ups and are gambling on these innovations taking hold

By the end of the four days the message was clear The question of innovation has to be approached by examining the business needs of any company in a non-static way Little would be gained by for instance just walking round the exhibition running concurrently with the conference and asking manufacturers what their machines could do Changes need to involve planning on the basis of looking at the organisation as a whole not chipping away at different departments in a haphazard fashion Crucial to successful changes are the support and participation of staff at all levels of a company Whether the delegates were convinced by these arguments remains to be seen ■

- *Eileen Phillips is at present working for a research project on office work and new technology based at the City of London Polytechnic She has a particular interest in the consequences for women office workers of technological innovation*

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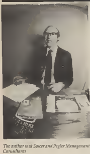

The author is at Spicer and Pegler Management Consultants

New Book-keepers Start Here

There are a dozen ways of keeping the books Here are some options

To duck the problem remember to fill in the cheque stubs and keep a copy of the invoice for everything you sell and everything you buy And once a year pass the whole thing to your accountant for him to perform a secret rite called incomplete records accounting Using a computer he can do the whole thing in two hours flat producing beautiful accounts for you to show to the bank manager You may also have a VAT Commitment – in which case he will have to perform quarterly

Hire some help ...get a book keeper in half a day a week – or mail the documents to him at his office

Put in a terminal ... use a terminal to one of the several computer service bureaux preferably one that specialises in your particular trade

Join the computer age — buy your own computer with some package programs

Just to do the books the last two alternatives are likely to be more expensive unless the volume of transactions is large But if you want to do a little more than this then there can be some advantages You can have

- up to date accounts not waiting until the work has been done elsewhere
- stock accounting on a day to day basis
- cash control – to know what you should be receiving and how much you have to pay this week
- Cash Flow forecasting – keep a forward rolling forecast of your cash position so that you can warn your bank manager of impending problems before he warns you after the event

Management Planning budgeting, profit analysis, etc – most computers can do all this But book-keeping problems have traditionally followed book-keeping practice there tends to be a sales ledger and a purchase ledger and a nominal ledger and a cash book and stock accounting, so it is all divided up and you cannot see at a glance how the business is doing today

With a computer it is theoretically possible to pull it all together This tends to work best with small numbers of transactions each month When the business becomes larger it becomes necessary to have better and tighter control, and thus you get with specific ledger programs for each aspect of the business

The Farmfax Accounts Package addresses the smaller business and provides all the advantages quoted above And it does this for a price the smaller business can afford and with a great simplicity

New Computer Users Start here

One of the biggest constraints on the purchase of a computer is the size of the disc store It has become the custom to hold only one copy of anything this not only saves space but also prevents errors If there is more than one copy then over the course of time the several copies will become different and you have difficulty finding out which copy or indeed if any of the copies, is correct

With book keeping systems, double entry book keeping requires two copies, one debit one credit There have to be procedures for balancing the books and if they are found not to balance then to locate the difference and correct it Sometimes, on computers, only one of the entries is shown in detail the other is represented by day book listings and totals on a control account, but the correction procedures need to be the same

Coming up from another direction are proponents of the database The party line here is, that it is very difficult to put any data onto the computer files into a sequence which is useful for *more than one purpose* So if you want to use the data for a second purpose you have to sort it into the required new sequence before looking at it And this takes time If you want the data for a *dozen* purposes then that means a dozen sorts It gets so that the original order is unimportant And in that case why bother to sequence it? Stuff it all on the file as it arrives and *look at it afresh* for each new use Like stuffing slips of paper into a gunny sack, when you want to look at anything then tip the whole thing out and look at each piece of paper

Computers search quicker than humans and for reasonable size files this works OK But there are some gimmicks which can be used to speed up a search which it is known in advance will be required and which is likely to be required often

First there is a *chain** On the Farmfax system there are two such chains one on the invoice date and the second on payment date So that if you start from June 1st (800601 in the computer) then there is a *pointer* in a *master record* to the first item entered into the system on that day Within that *transaction* record there is another pointer taking you to the second transaction And so on until the end of June 1st and so on through June 2nd and on to June 30th The last transaction there has a pointer *back to* the master record In order that you can insert another transaction into the file in the middle of the month, each record also has a *backward* pointer to the previous transaction On Farmfax there is also a forward and backward pointer for the payment date Four pointers per transaction So with no trouble at all you can pull out all the invoices or payments for any day or any month in the correct order

There is of course the overhead of *extra file space* for pointers and processing time to search through chains, but this can be a very neat way of storing data Simply put the transactions in one after another, have the computer assign a serial number to each all in one big file The systems will create the chains and will produce the transactions in date order on request

---

*See Dr Darrel Ince's series *Handling Data* which starts in this issue

Two other ways of getting at the information For any specific request for a few particular items of data the computer program can look at each item on a chain and select out only the items required. Farmfax does this too

For items which are going to be required often and fast then the computer programs can build up a list and sort only the list into the correct order of the items to be selected It can then pull them off the file directly This is done all the time in this package when preparing long reports for printing

Major users of big mainframe computers have very large files organised in this way On microcomputers the user who has a reasonable number of records can get the same advantages Users will get acceptable response to all requests for reports in place of brilliant response to only one

History of the Package

Farmfax was produced originally for farmers based on the experience of Geoffrey Paterson on his arable and cattle farm at Stockbridge Hants Farmfax now have 12 staff at Stockbridge including 6 systems people who are developing the packages further

The full range of software includes Accounts and Payroll together with planning packages specifically for cattle, pigs and arable farming The planning packages seek to identify individual animals and fields and measure their performance against the cost of their management So that for example an individual cow should receive the right amount and type of food to deliver the maximum economic amount of milk, and the system would identify the best cows to be kept back from being sold to the butcher In the same way arable fields would receive economic amounts of seed, fertilizer and chemical spray, and the system would help the farmer plan for break crops of peas beans, beet or oil seed rape to ensure maximum production of the main crops in future years

Farmfax payroll is said to be particularly easy to use On the farm at Halstead in Essex where I used the system the farmer (Chris Gosling) hates book-keeping Now with the payroll program set up for his six man staff he can do the weekly payroll in just 8½ minutes Previously it took him an hour and he reckons that he can now do something much more useful with the time he has saved

Farmfax programs run on the Northstar Horizon and the IMS 8000 Within the range there is a choice of memory sizes disk file sizes and types printers and displays They seem to be very pleased to tailor the systems according to particular needs and will advise which configuration would be appropriate As in any computer application it is very desirable to *measure your particular requirement* so that you buy a system of the right size for you

The configuration we used at Halstead was a 32K Horizon with two single-sided double density discs (each 180K) and a HP2621H visual display which has a thermal printer in the top Cost including the Accounts package would be £4950 The IMS 8000 configuration with bigger discs would be £6888

Twenty eight systems are currently installed, with 15 on order It is known that a number of additional sales are pending awaiting the new version of the Arable and Pig packages Sales are made by five full time salesmen In addition there are three Agent Farmers who have demonstration packages installed Maintenance is either from Stockbridge or via DDT for third party maintenance

With the appointment of an agent in Central London later this summer will come a marketing drive to sell the Accounts package into other industries and commerce Besides the existing interest from farming clients at our Cambridge office I am looking at it for use in a shipping agency where the ease of use cash flow planning and enterprise accounting applied to each ship in the fleet will be very appropriate I understand that two commercial sales have already been made one of them to the clothing industry

There is another package with a similar name Farmplan from Ross on Wye with similar farming parentage This runs on Apple or ITT 2020 computers I do not know whether Farmfax or Farmplan would suit you best This article only discusses Farmfax and only describes the Accounts package

Stages Implementation

The system is based on a single general purpose record type Use of this record type depends on the needs of the user The user can therefore start using Farmfax in a very simple way, and then graduate to new features so as to control his business better as he gets used to the system

Each record has a unique serial number which can be used to reference it or you can search for the record by reference to the data in the record. The fields within the record are Invoice Date, Payment Date Trader Code Trader Title, Description, Cost Centre Code Cheque No VAT Rate Gross Amount VAT Amount, and a Reconciled marker

Stage 1 _ Receipts and Payments

Keeping it very simple key in the details of each payment made, and each receipt of cash The payment date is the key date Ignore the Trader code, enter the cheque number and the supplier name goes into the Trader Title Description is to describe the entry Cost Centre Code is for the expense or receipt analysis VAT Rate Code Gross Amount and VAT Amount are self explanatory Prompts appear on the screen to help key in the transaction The transaction serial number is assigned automatically You can change any item at any time If you have to change a transaction after it has been marked as paid then a new transaction is opened up, cross-referenced to the previous one, which is cancelled

Two additional things can be done at this stage When the bank statement is received each item on the statement is keyed in. The relevant entry is identified by the program from the cheque number and all the matched items checked off with the Reconciled marker Any outstanding items or items not matched are highlighted for investigation

Secondly if the item description is keyed in with a *prefix, it is identified as a Stock item of Fixed Assets, and having entered the item a separate record is referenced entering the purchase of a new tractor, or additional quantities of seed or fertilizer

The vital first step here is to set up the Cost Centre codes On the smallest system Income codes are in the range 1-39 and Expenditure 40-141 It is recommended to put the financial and overhead items at the end And it is a good idea to leave some gaps so that you can add some more items It is not easy to change your mind after you have started to run with a particular chart of cost codes At the same time up to 100 Stock items and 100 Fixed Assets items can be named

VAT is analysed from Income cost codes 38 and 39 and Expenditure cost codes 140 and 141 There are suitable reports for listing VAT items for Customs and Excise returns, including a completed VAT form if desired

Accounts can be run as often as you wish To do this for the first time Group Titles are set up in the order desired and the appropriate cost centre codes specified in the order required to be shown within each group If you want to summarise a number of codes under a single title this can be done by a system of analysis letters; thus all the items marked with a C will be added together, and all the D's, etc

More simply the Nominal Ledger can be printed in Cost Centre Code order either in detail or as a Trial Balance showing totals only And a cash paid and received list shows the current cash position When run at week or month end this provides a hard copy record for the archives

Stage 2 _ Purchase Ledger

A stage up from pure receipts and payments specifies the names of suppliers and assigns these codes, on the smallest system these will be in the range 4-350 Having done this, then all new entries made will reference the Trader Code and the invoice date inserted in the Invoice Date field It is possible also to have the system look ahead and tell you how much you should pay each week some time ahead, a form of cash flow forecast

There is a list of creditors and a control account so that the total of items entered, the cash payments and opening and closing balances can be reconciled All this is done by reference to the Invoice Dates and Payment Dates

Stage 3 _ Sales Ledger

The same facilities are available for Sales Invoices and they are handled in exactly

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the same way The system can tell the difference because of the different Cost Centre codes Sales items and Purchase items can be shown for the same trader they are not netted off

Cash flow analysis now becomes more meaningful and you can begin to plan ahead and enter Budget items You can enter budgets either for cash movements, or for trading income and expense not both And you cannot get from one to the other So if you have set it up for Cash Flow is is not very relevant to show these items against the monthly accounts as budgets

The cash flows or budget items are set up with special instructions to put equal amounts right across the page, or for particular months, or for quarters And the reports can be actual for year rolling for last 12 months or for quarters And the budget items can be increased by a percentage if desired to help set up future budgets

Stage 4 — Enterprise Analysis

On the smallest system, up to 10 different parts of the business can be identified as separate enterprises So that on a farm these could be milk beef, pigs winter wheat sugar beet etc For my shipping agency client each ship is an enterprise For a garage there will be forecourt sales repairs vehicle sales I wanted 25 enterprises so I neded more memory on the Horizon, or the bigger system (the IMS 8000)

Each such enterprise has its own set of cost centre codes, typically about a dozen or 20 codes per enterprise So that at the end of each period each enterprise has its own account set up and run to show the profit or loss of that enterprise You can group two or more enterprises together or show one account for the whole business There is nothing very cunning about this you merely define a *group title* on the accounts and pull out all the several cost centre codes to be added to it

It is very useful to have budget comparisons on these enterprise accounts and this can be combined with Cash Flow forecasting on the receipts and payments of the business as a whole

Stage 5 — Stock Accounting

Some businesses have this problem some do not There is the facility in Farmfax to identify quantity and value of stock in up to 100 Stock numbers A special program can take material, at the appropriate average price valuation, out of stock and charge it to a cost centre code At the end of the accounting period a valuation can be entered into each stock account and the balance charged to an appropriate cost centre code

As an alternative on the Farmfax planning programs there are facilities for planning to spread fertilizer and chemical sprays and to use feedstuff and then to move the stock out of the bin record onto the field record or to individual animals This is probably a [illegible] stock movement [illegible] updates the accounts [illegible]

For non farmers [illegible] blems The accounting [illegible] be used as appropriate [illegible] signed for day to day sales [illegible] for stock re-order, sales statistics or profit margin calculation For these things there are better programs on the market

Summary

I like the way this system can be used simply and then grow more sophisticated as you gain experience with computers or as your business needs grow And I like the way the same programs are available on a range of machines so that the computer facility can be enhanced as the business grows, perhaps even to integrate the accounts with another company on merger

Cash Flow and Budgeting must be the key to proper control of the business The facilities for this seem very simple to use and give very workmanlike reports showing running totals for cash flow of the amounts the Bank Manager will have to be persuaded to advance until the seasonal sales come in

There are a number of very neat features in the system The printer on the Hewlett Packard visual display is nice whatever is shown on the display can be printed on the touch of a button The way the program helps the user to minimise data entry time the date will be assumed to be today's date or you can enter a day number and the system will accept the month and year as being the current period The Trader Code can be entered or if you don't know it then type in the first few letters of his name and the program will find the nearest fit and display it for approval before going ahead

The commands are consistent a feature not always found on these packages, on each facility you can display or print and having done this for a page you have the option to say no more and to go back to the last menu to carry on with something else A useful feature was apparently quite difficult to implement A button on the back of the Horizon processor box takes you out of the current facility, protecting the files from damage and gets you automatically back to the main menu again for a restart A useful feature, and again not often provided

One or two things not perfect for me I am not certain that the assignment of cost centre codes to enterprise accounts is going to be as easy to use for larger companies as I would like

And the handling of credits, accruals and prepayments is not as elegant as I have seen elsewhere Farmfax appreciate that the Profit and Loss Account and Balance Sheet need tidying up and this will be done as soon as the needs of actual users become more clear

For cash flow budgetting or analysis to several different enterprises this could be the package for you ■

Editor's Note *Readers are reminded that every month the Applications section of Brand News gives brief details of different packages available*

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- SELECT FUNCTION BY NUMBER
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From the next issue onwards, there will be an additional prize for letter writers a copy of Martin Banks' new book *Living With The Micro*, published by Sigma Technical Press at £4 50

■

The quality of society

Stephen Bodington's article on the social aspects of technological innovation was a welcome demonstration that computer magazines can have a healthy outlook on life. Technology has always been a major force in shaping societies and a thorough understanding of its rôle would be very desirable. Such an appraisal becames more urgent as the dawn of the intelligent machine approaches. It is also apparent that the traditional methods of producing wealth are far from being satisfactory.

I have often felt that many technological artifacts do not really improve the quality of life and many people receive somewhat inhuman treatment at the hands of their employers. These and other observations strongly suggest that industrial structures ought to be changed perhaps along Small is Beautiful lines.

The problem of course is to persuade people to adopt new ways of living. Our flip flop style of government and the sea of economic ideas in which we live means that this will be a very difficult task indeed. Hence I believe that ideas of a political nature should be given a platform in *Computer Age* though they would need to be restricted in some way. Politics is too important to be left to those who pursue it as a career – and what do our MPs know about information technology anyway? Some people may [illegible] things but the issues are imp[illegible]

I will not set out my own beliefs here but there are [illegible] books that I think technologists and the like should read. *Small is Beautiful* (E F Schumacher) is thought provoking and seems to be based largely on *The Acquisitive Society* by R H Tawney. *Economics of the Real World* by Peter Donaldson is a surprisingly refreshing work by a respected economist. The books by J K Galbraith also show a more enlightened approach to theorising. Finally *Understanding Media* by Marshall McLuhan suggests interesting new ways to look at the effects of technology and money.

Perhaps it is too much to hope for but I believe that planned radical change in the fabric of our society will be welcomed by many. The probable alternative is to let the machines and those who control them dictate our life-styles for us.

R D Prosser, 98 Burnham Walk, Farthing Corner Rainham Kent
a £10 book voucher

Things are getting better

Alan Simpson in his article Small scale users large scale problems is correct in much of what he explains. However there are people who are aware of the problems and are active in a practical way.

NCC has been active in the micro field for some time. In particular a study of applications software packages for microcomputers has just been completed and will be published in August as an NCC guide.

This work has been reported in the press and many NCC members have received advice and guidance from the project team.

NCC has also initiated its Computer Guidance Service aimed specifically at the first time user. This service was piloted in the Birmingham area and will be extended soon

Computer Age & business COMPUTING

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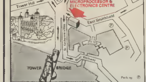

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The Centre, situated in one of the most beautiful areas of London, near the Tower of London, is at the World Trade Centre, Europe House, London E1 9AA. It is a permanent exhibition and showcase for enterprising computer and electronics companies such as

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Letters

The Service has several features: a clinic (where you can discuss your problems with an NCC advisor), a series of talks and a manual and assistance from an NCC advisor. The NCC has also produced a brochure entitled *Introduction to [illegible] computer* which is available free.

Microcomputer retailers are also aware of the problems. They have formed the Computer Retailers Association. The Association has a code of practice for its members designed to protect the buyer from an unscrupulous sales approach.

Lyndon Morgan, Microprocessor Team Leader, Distributed Computing Division, The National Computing Centre Limited, Oxford Road, Manchester M1 7ED

Feedback

I was interested to see that your paper is to carry a series of articles on Cybernetics by Saeed Sheikh. I found the first of them most readable and would hope that they will all hold the attention of managers. There is no doubt that the most important fact of life today is the rate at which things are changing; this in turn demands of all of us the capacity of adapting to change. The essence of adaptation is communication and control, and I feel that what Mr. Sheikh has to say on it is as useful as it is clear.

Prof. R. W. Revans, 8 Higher Downs, Altrincham, Cheshire WA14 2QL

Clarity is all

As a retired power engineer and a committee member of the N. and E. London Branch of the British Institute of Management, presently engaged on an occasional basis in management education and training at practical and production levels, one of my main interests is to help create understanding between the schisms of Education, Training, Commerce and Industry.

With this in mind I have read with great interest the article on Cybernetics in the June issue of your journal entitled *The Helmsman* by Saeed Sheikh.

I find the concepts and philosophy incisive and analytical and yet at the same time propounding in a clear cut manner the form of the subject.

I look forward to other articles in this series in your future journals.

T. J. Gable C.Eng., M.I.E.E., M.Inst.E., M.I.B.I.M.
3 Gloucester Gardens, Cockfosters, Barnet, Herts

Management problems

A short note to say how much I enjoyed the Saeed Sheikh article on Cybernetics.

As a (non-technical) Training Officer, I feel the application of cybernetic and systems thinking to management problems is one of the most exciting and worthwhile activities to come forward for some time.

I look forward to future articles.

D. Osbourne, Huntingdon Research Centre, Huntingdon, Cambs PE18 6ES

Education

I would like to express my appreciation of your coverage to date. It has been consistently interesting and informative, surpassing competitors particularly in my field of educational computing (I am a research student with the Schools Council *Computers in the Curriculum* project). You provide a rather more readable, broad-based and up-to-date account of the current scene than is available in research papers.

I would like to know more about the following areas of development, which have, I think, all been touched on in previous articles:

1. Information Retrieval applications with micros
2. Information Retrieval packages [illegible] schools have used FIND for [illegible] or What [illegible] is available for micros apart from Herts QUERY software?)
3. Applications with the 8-13 age range (other than ITMA)
4. Pupils' views of their interaction with the computer (especially in 8-13 age range)

Judging from impressions gained at the recent CLC Conference (Nottingham), many people are interested in developments on these fronts, and I know that the Ealing School of Librarianship is also interested in the first two.

Ms. R. Parry Jones, 3 Brierley Court, Church Road, Hanwell, London W7
• £5 book voucher

Seeing versus Looking

Following your article on ITMA in the April issue, I should like to draw the attention of any of your readers who propose to use microcomputers as a teaching aid. Some students just do not seem to learn effectively from them, in particular slow learning children for whom one would imagine it to be the ideal medium with its endless patience and repetition on demand. Research carried out at our Learning Centre in Houston, Texas, over the past seven years has shown that failure to learn from a computer was almost always linked to inadequate visual perception skills. Therapy to improve visual discrimination and visual memory usually resulted in a big improvement in the student's ability to learn from computer based instruction. So much so in fact that eventually we had all our students undergo visual perception training prior to using the microcomputer.

Nancie Reid, B.Sc., M.Sc. (Director), Clear Lake Learning Centre, 73 Mount Anville Park Estate, Dublin 14

Computers in Schools

With reference to the article *Imperative Interface* in the April (No. 5) issue of Computer Age (p. 34).

But for the forseeable future the programmer shortage will continue. The obvious place to alleviate the shortage is the school.

A major effort is needed to educate authorities about small computers, their cheapness, versatility and utility.

The first quotation cannot be denied, but anyone with experience of schools would take issue with the second statement. The starting point for the introduction of new teaching techniques into schools is with the teachers and Head Teachers, not with the LEAs. When AV (Audio Visual) Aids were introduced into schools in the 1950s it was noticeable that where the pressure for this new equipment came from the schools the equipment was used and used efficiently. Where equipment came into schools as a result of pressure by the LEA through their advisory service, the expensive equipment remained on shelves, gathering dust.

If teachers and Head teachers are convinced of the value of new equipment they will soon bring pressure to bear on LEAs and Parent Teacher Associations to ensure that their school does not lack what is necessary. The bulk of the purchases of school materials – equipment and software – is in the hands of the Head Teacher; he is given the money to spend, he signs the requisitions. Most Heads consult their Heads of Department and the teachers. Head Teachers of Secondary schools are well aware of computers, indeed they will have them in their Maths/Science departments and they are training future programmers. And in spite of the efforts of the schools there is a woeful shortage of programmers.

But the start is at the wrong point in the education ladder; the proper point of origin for new techniques and for lasting results is in the *primary school*. (From a commercial sales point of view, there are thousands more Primary schools than secondary.) Industry should woo the teachers and Head Teachers in the Primary field, should see that these teachers appreciate the help computers can give them in relieving them of the drudgery chores – marking and recording, and can make preparations of lessons easier and more interesting, opening up for them a vast range of visual aids at the push of a button. Teachers in Primary schools have to be taught to overcome their fear of computers. They have to be given the opportunity to play with them, to design their own programmes for the particular school, to make working models through playing with computers; they will find the need to introduce them into teaching, the classroom and, for Head Teachers – the school office. Few schools have enough clerical assistance.

Teachers, however, are chary of the commercial course. Often the instructor comes with the hard sell more fitted for the middle management of large firms. Teachers are more prepared to accept the commercial instructor who comes through a well defined educational source – The Teachers Centre winter programme, a teachers' organisation such as the Educational Development Association where, by discussion with the directors of the educational programme the hard sell has been tempered and the course geared to schools instead of offices.

The Educational Development Association mentioned above is one of the oldest of the voluntary teachers' organisations concerned with the in-service training of teachers. It has since the 1880s been advocating the need for teachers to keep themselves up to date through regular attendance at courses (evenings, week-ends, summer schools). To this end it arranges evening lectures, week-end seminars and summer schools (in 1980, five summer schools including one in the United States).

Give me a child up to seven, was a well proven adage of the Jesuit educators – It still holds good today. The place to start with educational innovations is in the Primary school. If primary children see computers as a normal part of their daily classroom life, then perhaps the cry, there is a desperate shortage of programmers, will no longer be heard.

Arnold W. Zimmermann, Director of Studies, Educational Development Association, International School, 5 Windmill Gardens, Enfield EN2 7DU

Editor's Note *Readers can add the Educational Development Association to their list of sources of advice and help.*

Please keep in touch

The British Computer Society has a Committee for the Disabled, among whose aims are the development of computer-based aids for the disabled.

There is in this country a number of people developing aids for sufferers from almost every kind of disability, and the advent of the microcomputer has accelerated the trend to new inventions. So far there has been far too little done by way of providing a means whereby such people can get in touch with each other and find out what has been done and what is being attempted; indeed a wheel has been re-invented on occasion. Many aids have been invented and developed 'one-off' by the inventor for himself or for a friend or relation. Such an inventor could have gained help from contact with others working on the same or a similar problem. As a first step towards the information service which we believe essential

We're as good as our past – see for yourself.

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SUBSCRIPTION DETAILS ON PAGE 94

the s[illegible] m[illegible] llecting the names and addresses [illegible] and organisations working in this fi[illegible] [illegible]uld be very glad to hear from any wh[illegible] interested whether as sufferers inventors [illegible] manufacturers. We feel sure that this is not merely a national problem and are seeking similar help via organisations for information science in most of the English speaking world.

May I, through you, ask any who could contribute, or even who wish merely to comment, to get in touch with me?

Helen M. Townley, Sub-Committee on Information Service, The British Computer Society, 13 Mansfield Street, London W1M 0BP

Sponsor needed

I have been offered a place at Cambridge University to read for a first degree which will comprise: Part 1 Anglo Saxon linguistics and linguistic and literary computing (usually reserved for postgraduate degrees but I have permission to study it); Part 2, computer science.

I cannot obtain a grant because I am a qualified teacher (mathematics, including A level). Do you know of any firm, any establishment whatever, which might be willing to sponsor the further education of a teacher in this field — I don't need to tell you very few, if any, teachers have studied linguistics and literary computing, and I consider it a matter of some priority that this situation be remedied.

I would be extremely grateful for any help you can give.

Mrs Maria Mitchell, 8 Priory Road, St Bees, Cumbria ■

APL Series

▶ *from page 66*

```
(ρX)⌈5+ρY
```

" the larger of the number of terms in X and 5+ the number of elements in Y.

The next and final primitive is ⍴. Recall that everything to the right of a primitive is its right argument. Is ⍴ here monadic or dyadic?

As the symbol immediately to its left, – namely "4" – is not a primitive, it is dyadic here so we have "the 4 reshape" of something.

The whole expression can be summarised in words as "the 4 reshape of the larger of the length of X and 5 plus the length of Y".

We advise that in the early stages of your APL studies to write expressions simply, such as

```
R←5+ρX
R←(ρX)⌈R
R←4ρR
```

which is equivalent to the compound expression above. We have retained the temporary variable, R, to avoid a proliferation of temporaries in the workspace. ■

●*To be continued*

Alan Pearman's company, APL Ltd, specialises in APL and markets its own APL system, the MAPLE.

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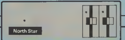

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